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International survey among surgeons on laparoscopic right hemicolectomy: the gap between guidelines and reality

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Abstract

Introduction To assess the current approaches and perioperative treatments of laparoscopic right hemicolectomy (LRHC) and to highlight similarities and differences with international guidelines and scientific evidence, we conducted a survey for surgeons across the globe.

Methods All digestive and colorectal surgeons registered with the database of the Research Institute against Digestive Cancer (IRCAD) were invited to take part in the survey via email and through the social media networks of IRCAD.

Results There were a total of 440 respondents from 78 countries. Most surgeons worked in the European region (38.6%) followed by the Americas (34.1%), the Eastern Mediterranean region (13.0%), the South-East Asian region (5.9%), the Western Pacific region (4.8%), and Africa (3.2%) respectively. Over half of the respondents performed less than 25% of right hemicolectomies laparoscopically where 4 ports are usually used by 68% of the surgeons. The medial-to-lateral, vessel-first approach is the approach most commonly used (74.1%). The most common extraction site was through a midline incision (53%) and an abdominal drain tube is routinely used by 52% of the surgeons after surgery. A total of 68.6% of the responding surgeons perform the majority of the anastomoses extracorporeally. Finally, we found that the majority of responders (60.7%) routinely used mechanical bowel preparations prior to LRHC.

Conclusion Regarding several topics related to LRHC care, a discrepancy was observed between the current medical practice and the recommendations from RCTs and international guidelines and significant regional differences were observed.

Keywords Laparoscopic right hemicolectomy · International survey · International guidelines

Colorectal cancer is the third most common malignant disease in the world with over two million new diagnoses and 862,000 deaths in 2018 [1]. Approximately 40% of all colorectal cancers are located in the right hemicolon. Several studies have reported on the advantages of laparoscopic surgery compared to open surgery [2–4]. Due to its benefits, the laparoscopic approach has become the standard procedure for colon cancer surgery. However, due to the anatomical complexity and numerous variations in the branching pattern of vessels [5, 6], various approaches for the laparoscopic right hemicolectomy (LRHC) have been described and there is no consensus on the preferred method.

Several accessible guidelines [7, 8] have been published on the perioperative management of colorectal surgery to help improve clinical outcomes. In this study, we conducted an international survey among surgeons from across the globe to assess the current reality of LRHC worldwide.

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Methods

A web-based 13-item survey was designed to assess the surgeons' therapeutic approaches, as well as preoperative and postoperative treatments related to LRHC. The questions surveyed are shown in Table 1. Digestive and colorectal surgeons registered with the WebSurg and IRCAD database (https//www.websurg.com), who originate from all over the world were invited to take part in the survey via email prior to an online course on LRHC. Other participants were invited through the social media networks of IRCAD. The survey was accessible for a duration of 1 week (June 2020). The participation in the study was voluntary and participants completed the questionnaire anonymously. The questionnaire could only be submitted once per participant. Returned questionnaire forms were summarized for analysis. Due to the nature of this study, Institutional Review Boards (IRBs) approval or informed consent were not required.

Statistical analysis

The data were collected and recorded in a commercially available database (Excel spreadsheet; MICROSOFT CORP, Redmond, WA, USA) for subsequent statistical analysis. For surveyed questions with only two options, odds ratios (OR) and 95% confidence intervals (CI) were calculated. For questions with more than two options, the Pearson Chi-squared test was used to analyze the results. A p value < 0.05 was considered statistically significant. When Chi-squared statistics were found to be statistically significant, adjusted standardized residuals (ASR) $\geq \pm 1.96$ were used to identify the results that significantly deviated.

Results

Characteristics

A total of 440 surgeons from 78 countries participated in the study and completed the questionnaire. The characteristics of the respondents are shown in Fig. 1 and Table 2. Four hundred and thirty-eight (99.5%) surgeons provided information about their country of residence. The countries were classified into their corresponding regions as defined by the World Health Organization (WHO) [9] and a detailed table of number of respondents per region and country is provided in Supplemental Appendix 1. Most surgeons who completed the questionnaire worked in the European region ($n = 170$) followed by these regions: the Americas ($n = 150$), the Eastern Mediterranean region ($n = 57$), the South-East Asia region ($n = 26$), the Western Pacific region ($n = 21$), and Africa ($n = 13$) respectively.

The age distribution of the respondents showed that most respondents were in their 40s ($n = 143$, 32.5%) followed by respondents in their 30s ($n = 119$, 27%), 50s ($n = 103$, 23.4%), 60s or above ($n = 56$, 12.7%), and respondents in their 20s ($n = 19$, 4.3%) respectively.

Over half of the respondents performed less than 25% of right hemicolectomies laparoscopically ($n = 221$, 50.2%) followed by 23.4% ($n = 103$) performing > 75% of the procedures laparoscopically, 15.7% ($n = 69$) performing 50 to 75% and 10.7% ($n = 47$) performing 25 to 49% of right hemicolectomies laparoscopically.

Surgical procedure

The anastomosis

Three hundred and two responding surgeons (68.6%) performed the majority of the anastomoses extracorporeally, the other respondents performing the majority of the anastomoses intracorporeally. There was no statistically significant difference between these two groups in terms of number of performed cases by the surgeon, years of experience, and percentage of LRHC out of the total RHC performed. In the Western Pacific region, respondents were more likely to choose the extracorporeal anastomosis (OR 4.565, 95% CI 1.162–17.858) and in the American region, respondents were more likely to choose the intracorporeal anastomosis (OR 0.577, 95% CI 0.381–0.876) (Table 3).

Surgical approaches

For LRHC, the medial-to-lateral, vessel-first approach is the approach most commonly used by surgeons ($n = 326$, 74.1%) followed by the inferior (lateral-to-medial) approach ($n = 90$, 20.5%), superior (lateral-to-medial) approach ($n = 18$, 4.1%), and other approaches ($n = 6$, 1.4%) respectively.

In the region of the Americas, a relatively large number of respondents performed the superior approach, in comparison to other regions. Respondents working in institutions where laparoscopic right hemicolectomy accounts for more than 75% of the surgical practice were more likely to perform a vessel-first approach (ASR: 5.61) (Table 3).

Specimen extraction site

For specimen extraction, 233 surgeons (53%) performed a midline incision, and 207 surgeons (47%) performed a Pfannenstiel's incision. In the Eastern Mediterranean region, respondents were more likely to choose a Pfannenstiel's incision (OR 3.699, 95% CI 1.998–6.845). In Europe and in the Western Pacific regions, respondents were more likely to

Table 1 Questions of the survey

Questions	Answers
1. What is your country of residence?	
2. What is your age?	20–29 years old
	30–39 years old
	40–49 years old
	50–59 years old
	60 years old or above
3. How many years of experience in laparoscopic surgery do you have?	< 5 years
	5–10 years
	11–15 years
	16 years or above
4. How many cases of laparoscopic right hemicolectomy did you perform as a 1st surgeon?	0–25 cases
	26–50 cases
	51–75 cases
	76–100 cases
	> 100 cases
5. How do you most commonly perform the anastomosis for laparoscopic right hemicolectomy?	Intracorporeally
	Extracorporeally
6. What is your usual approach to laparoscopic right hemicolectomy?	Vessel-first (medial-to-lateral) approach
	Inferior (lateral-to-medial) approach
	Superior (lateral-to-medial) approach
	Other approach
7. What specimen extraction site do you usually use for laparoscopic right hemicolectomy?	Cesarean/Pfannestiel/pubic incision
	Midline incision
8. Do your patients use bowel preparation/irrigation prior to laparoscopic right hemicolectomy?	Yes
	No
9. How many laparoscopic ports do you normally use during a laparoscopic right hemicolectomy?	Single port
	2 ports
	3 ports
	4 ports
	5 ports
	6 ports or more
10. Do you routinely use an abdominal drain tube after laparoscopic right hemicolectomy?	Yes
	No
11. Do you use antibiotics prophylaxis at the start of laparoscopic right hemicolectomy	No
	Yes, oral antibiotics
	Yes, intravenous antibiotics
	Yes, both oral and intravenous antibiotics
12. Do you routinely use postoperative prophylactic antibiotics after laparoscopic right hemicolectomy?	Yes
	No
13. When does your patient start solid oral diet after laparoscopic right hemicolectomy?	Same day of surgery
	POD (postoperative day) 1
	POD 2
	POD 3
	POD 4 or above

Table 1 (continued)

Questions	Answers
14. What is the percentage of the laparoscopic right hemicolectomies performed at your hospital?	< 25% of the total number of right hemicolectomies
	25–49% of the total number of right hemicolectomies
	50–75% of the total number of right hemicolectomies
	> 75% of the total number of right hemicolectomies

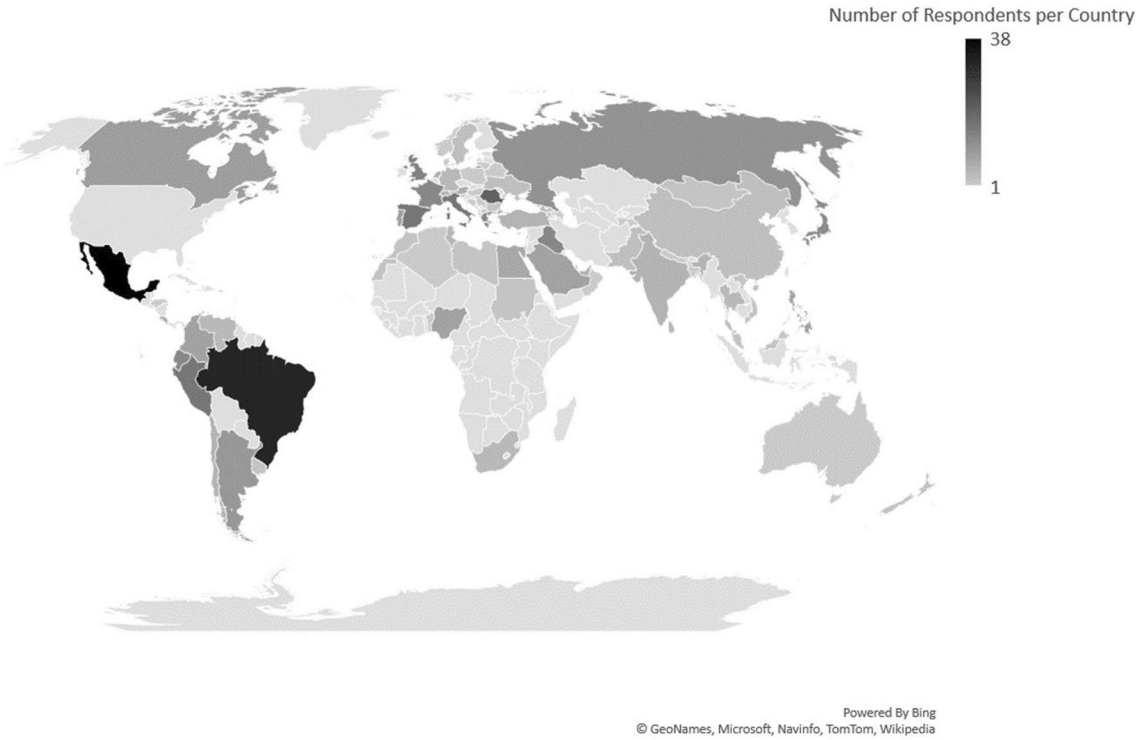

Fig. 1 Proportion to the total number of respondents per country. The number of respondents in this survey is colored per country. The color depth correlates with the number of respondents

choose a midline incision (OR 0.604, 95% CI 0.410–0.891; OR 0.250 95% CI 0.087–0.723, respectively). There was no correlation between the choice of the extraction site and the surgeons' age, number of laparoscopic cases, and experience in years (Table 3). Respondents who chose to perform an extracorporeal anastomosis were more likely to choose a midline incision, while those who chose an intracorporeal anastomosis were more likely to choose a Pfannenstiel's incision (OR 4.796, 95% CI 3.088–7.447).

Number of ports

The majority of responding surgeons performed the procedure with 4 laparoscopic ports ($n = 299$, 68%), followed by 5 ports ($n = 84$, 19.1%) and 3 ports ($n = 48$, 10.9%) respectively. Performing the procedure with a single port, 2 ports, 6 or more ports is performed by 3 responding surgeons for each approach. In the Western Pacific region, respondents were more likely to use 5 ports (ASR: 4.93). In cases where 3 ports are used for a LRHC procedure, the respondents were found to work in institutions where laparoscopic right hemicolectomy accounts for more than 75% of all right hemicolectomy cases (ASR: 3.60). There was no statistically significant difference regarding the number of performed cases and years of experience (Table 3).

Use of an abdominal drain tube

An abdominal drain tube is routinely used by 52% of respondents. More specifically, Eastern Mediterranean respondents are the most frequent users of abdominal drains (OR 2.415, 95% CI 1.331–4.378). There was no statistically

Table 2 Characteristics of the 440 participants who completed the survey

Variable	No. (%)
Age, years	
20–29	19 (4.3)
30–39	119 (27)
40–49	143 (32.5)
50–59	103 (23.4)
≥ 60	56 (12.7)
Experience (years)	
< 5	87 (19.8)
5–10	104 (23.6)
11–15	100 (22.7)
16	149 (33.9)
Experience (cases)	
0–25	285 (64.8)
26–50	77 (17.5)
51–75	31 (7.0)
76–100	20 (4.5)
> 100	27 (6.1)
Percentage of laparoscopic right hemicolectomy	
< 25%	221 (50.2)
25–49%	69 (15.7)
50–75%	47 (10.7)
> 75%	103 (23.4)
Region	
Africa	14 (3.2)
Europe	170 (38.6)
Mediterranean	57 (13.0)
South-East Asia	26 (5.9)
The Americas	150 (34.1)
Western Pacific	21(4.8)
No-answer	2 (0.5)

significant difference in terms of years of experience. However, surgeons working in institutions with a small percentage of laparoscopic right hemicolectomies and surgeons who perform fewer LRHC cases tend to routinely use an abdominal drain tube (OR 2.850, 95% CI 1.901–4.274, Table 3).

Perioperative management

Preoperative bowel preparation

Bowel preparation was routinely used by 60.7% of respondents ($n = 267$). Respondents who worked at a hospital with < 25% of the total number of laparoscopic right hemicolectomies and respondents who perform fewer LRHC cases more likely to use bowel preparation (OR 2.431, 95% CI 1.642–3.599; OR 1.716, 95% CI: 1.153–2.555, respectively). There was no statistically significant difference regarding the geographical regions and the years of experience (Table 4).

Use of prophylactic antibiotics

In relation to the question "*Do you use antibiotic prophylaxis at the start of laparoscopic right hemicolectomy?*," 433 surgeons (98.4%) answered "Yes" and 7 surgeons (1.6%) answered "No". Among those who answered "Yes", "intravenous administration of antibiotics" ($n = 372$, 84.5%) was the most commonly used, followed by both oral and intravenous administration ($n = 43$, 9.8%) and oral administration ($n = 18$, 4.1%). There was no statistically significant difference in terms of regions, number of performed cases, years of experience, and percentage of LRHC (Table 4).

However, postoperative prophylactic antibiotics were routinely used by 55.9% of respondents after a laparoscopic right hemicolectomy. In Europe, respondents are less likely to use postoperative antibiotics (OR 0.236, 95% CI 0.157–0.355). In Southeast Asia and in East Mediterranean regions, respondents are more likely to use postoperative antibiotics (OR 3.396, 95% CI 1.758–6.552; OR 10.378, 95% CI 2.679–40.070, respectively). Surgeons in institutions with a small percentage of laparoscopic right hemicolectomies and surgeons who perform fewer LRHC cases tend to routinely use postoperative antibiotics (OR 2.620, 95% CI 1.755–3.921). There was no statistically significant difference regarding the surgeons' age and years of experience (Table 5).

Oral intake

The most common answer to the question ''when does your patient start solid oral diet after a LRHC?'' was "Postoperative day (POD) 2" ($n = 130$, 29.5%) followed by "POD 3" ($n = 116$, 26.4%), "POD 1" ($n = 102$, 23.2%), "POD 4 or above" ($n = 56$, 12.7%), and on the same day of surgery ($n = 36$, 8.2%) respectively. There was no statistically significant difference regarding the surgeons' age and years of experience.

In Europe, patients are significantly more likely to resume oral intake on the same day of surgery in comparison to other regions (14%). Respondents who have a higher number of performed cases are more likely to allow the early resumption of oral intake after LRHC. Respondents who work at institutes with > 75% of RHC performed laparoscopically are more likely to allow resumption of oral intake on the same day as surgery (Table 5).

Discussion

In this survey, we have assessed the reality of LRHC among surgeons from across the globe. To the best of our knowledge, this is one of the largest international surveys to

Table 3 Data related to the intraoperative procedures

		Anastomosis			Approach					Incision		
		Extracorporeally ($n=302$)	Intracorporeally ($n=138$)	OR (95% CI)	Vessel-first ($n=326$)	Inferior ($n=90$)	Superior ($n=18$)	Others ($n=6$)	p value	Cesarean ($n=207$)	Midline ($n=233$)	OR (95% CI)
Age	20–29	8 (1.8)	11 (2.5)	0.314 (0.127–0.778)	14 (3.2)	1 (0.2)	4 (0.9)	0 (0)	n.s	12 (2.7)	7 (1.6)	1.987 (0.790–4.992)
	30–39	85 (19.3)	34 (7.7)	1.198 (0.757–1.896)	92 (20.9)	22 (5.0)	3 (0.7)	2 (0.5)		50 (11.4)	69 (15.7)	0.757 (0.496–1.156)
	40–49	100 (22.7)	43 (9.8)	1.094 (0.711–1.683)	108 (24.5)	27 (6.1)	5 (1.1)	3 (0.7)		67 (15.2)	76 (17.3)	0.989 (0.663–1.473)
	50–59	66 (15.0)	37 (8.4)	0.763 (0.480–1.213)	73 (16.6)	26 (5.9)	3 (0.7)	1 (0.2)		50 (11.4)	53 (12.0)	1.082 (0.697–1.680)
	≥ 60	43 (9.8)	13 (3.0)	1.596 (0.835–3.047)	39 (8.9)	14 (3.2)	3 (0.7)	0 (0)		28 (6.4)	28 (6.4)	1.145 (0.657–1.997)
Experience (years)	< 5	57 (13.0)	30 (6.8)	0.838 (0.511–1.372)	65 (14.8)	12 (2.7)	8 (1.8)	2 (0.5)	n.s	42 (9.5)	45 (10.2)	1.063 (0.666–1.697)
	5–10	71 (16.1)	33 (7.5)	0.978 (0.611–1.566)	82 (18.6)	20 (4.5)	0 (0)	2 (0.5)		49 (11.1)	55 (12.5)	1.004 (0.647–1.557)
	11–15	73 (16.6)	27 (6.1)	1.311 (0.800–2.146)	68 (15.5)	29 (6.6)	2 (0.5)	1 (0.2)		47 (10.7)	53 (12.0)	0.998 (0.639–1.557)
	≥ 16	101 (23.0)	48 (10.9)	0.942 (0.617–1.438)	111 (25.2)	29 (6.6)	8 (1.8)	1 (0.2)		69 (15.7)	80 (18.2)	0.956 (0.644–1.419)
Experience (cases)	0–25	199 (45.2)	86 (19.5)	1.168 (0.770–1.773)	204 (46.4)	62 (14.1)	14 (3.2)	5 (1.1)	n.s	136(30.9)	149 (33.9)	1.080 (0.730–1.579)
	26–50	56 (12.7)	21 (4.8)	1.268 (0.736–2.183)	56 (12.7)	17 (3.9)	3 (0.7)	1 (0.2)		33 (7.5)	44 (10.0)	0.815 (0.498–1.334)
	51–75	20 (4.5)	11 (2.5)	0.819 (0.386–1.733)	25 (5.7)	5 (1.1)	1 (0.2)	0 (0)		18 (4.1)	13 (3.0)	1.612 (0.779–3.331)
	76–100	10 (2.3)	10 (2.3)	0.438 (0.182–1.053)	20 (4.5)	0 (0)	0 (0)	0 (0)		10 (2.3)	10 (2.3)	1.132 (0.473–2.709)
	> 100	17 (3.9)	10 (2.3)	0.764 (0.346–1.683)	21 (4.8)	6 (1.4)	0 (0)	0 (0)		10 (2.3)	17 (3.9)	0.645 (0.294–1.418)
Percentage of LRHC	< 25%	154 (35.0)	67 (15.2)	1.103 (0.738–1.648)	150 (34.1)$^{-}$	56 (12.7)$^{+}$	13 (3.0)	2 (0.5)	0.03	117(26.6)	104 (23.6)	1.613 (1.107–2.350)
	25–49%	46 (10.5)	23 (5.2)	0.898 (0.522–1.545)	53 (12.0)	13 (3.0)	1 (0.2)	2 (0.5)		26 (5.9)	43 (9.8)	0.635 (0.376–1.072)
	50–75%	33 (7.5)	14 (3.2)	1.087 (0.566–2.083)	34 (7.7)	11 (2.5)	2 (0.5)	0 (0)		22 (5.0)	25 (5.7)	0.989 (0.543–1.802)
	> 75%	69 (15.7)	34 (7.7)	0.906 (0.567–1.448)	89 (20.2)$^{+}$	10 (2.3)$^{-}$	2 (0.5)	2 (0.5)		42 (9.5)	61 (13.9)	0.718 (0.460–1.121)

Table 3 (continued)

		Anastomosis			Approach					Incision		
		Extracorporeally (*n* = 302)	Intracorporeally (*n* = 138)	OR (95% CI)	Vessel-first (*n* = 326)	Inferior (*n* = 90)	Superior (*n* = 18)	Others (*n* = 6)	p value	Cesarean (*n* = 207)	Midline (*n* = 233)	OR (95% CI)
Regions	Africa	12 (2.7)	2 (0.5)	2.814 (0.693–11.363)	11 (2.5)	1 (0.2)	1 (0.2)	1 (0.2)	0.003	6 (1.4)	8 (1.8)	0.840 (0.299–2.359)
	Europe	124 (28.2)	46 (10.5)	1.393 (0.915–2.121)	139 (31.6)$^{+}$	27 (6.1)	3 (0.7)	1 (0.2)		67 (15.2)	103 (23.4)	0.604 (0.410–0.891)
	Mediterranean	36 (8.2)	21 (4.8)	0.754 (0.424–1.340)	40 (9.1)	12 (2.7)	2 (0.5)	3 (0.7)$^{+}$		42 (9.5)	15 (3.4)	3.699 (1.998–6.845)
	South-East Asia	19 (4.3)	7 (1.6)	1.256 (0.527–2.987)	16 (3.6)$^{-}$	9 (2.0)$^{+}$	0 (0)	1 (0.2)		8 (1.8)	18 (4.1)	0.480 (0.209–1.106)
	The Americas	91 (20.7)	59 (13.4)	0.577 (0.381–0.876)	101 (23.0)$^{-}$	37 (8.4)	12 (2.7)$^{+}$	0 (0)		79 (18.0)	71 (16.1)	1.408 (0.949–2.090)
	Western Pacific	19 (4.3)	2 (0.5)	4.565 (1.162–17.858)	17 (3.9)	4 (0.9)	0 (0)	0 (0)		4 (0.9)	17 (3.9)	0.250 (0.087–0.723)

		Ports						p	Drain tube		
		Single (*n* = 3)	2 ports (*n* = 3)	3 ports (*n* = 48)	4 ports (*n* = 299)	5 ports (*n* = 84)	≧6 ports (*n* = 3)		Yes (*n* = 229)	No (*n* = 211)	OR (95% CI)
Age	20–29	1 (0.2)	0 (0)	3 (0.7)	11 (2.5)	4 (0.9)	0 (0)	n.s.	16 (3.6)	3 (0.7)	5.208 (1.596–16.941)
	30–39	0 (0)	2 (0.5)	18 (4.1)	83 (18.9)	14 (3.2)	2 (0.5)	n.s.	55 (12.5)	64 (14.5)	0.726 (0.477–1.106)
	40–49	0 (0)	0 (0)	11 (2.5)	98 (22.3)	33 (7.5)	1 (0.2)	n.s.	77 (17.5)	66 (15.0)	1.113 (0.747–1.658)
	50–59	2 (0.5)	1 (0.2)	7 (1.6)	78 (17.7)	15 (3.4)	0 (0)	n.s.	52 (11.8)	51 (11.6)	0.922 (0.594–1.431)
	≥ 60	0 (0)	0 (0)	9 (2.0)	29 (6.6)	18 (4.1)	0 (0)	n.s.	29 (6.6)	27 (6.1)	0.988 (0.567–1.723)
Experience (years)	<5	1 (0.2)	2 (0.5)	12 (2.7)	56 (12.7)	16 (3.6)	0 (0)	n.s.	49 (11.1)	38 (8.6)	1.239 (0.775–1.983)
	5–10	0 (0)	0 (0)	11 (2.5)	73 (16.6)	18 (4.1)	2 (0.5)	n.s.	48 (10.9)	56 (12.7)	0.734 (0.473–1.139)
	11–15	1 (0.2)	0 (0)	8 (1.8)	72 (16.4)	18 (4.1)	1 (0.2)	n.s.	55 (12.5)	45 (10.2)	1.166 (0.747–1.821)
	≧16	1 (0.2)	1 (0.2)	17 (3.9)	98 (22.3)	32 (7.3)	0 (0)	n.s.	77 (17.5)	72 (16.4)	0.978 (0.659–1.451)
Experience (cases)	0–25	2 (0.5)	3 (0.7)	25 (5.7)	187 (42.5)	65 (14.8)	3 (0.7)	n.s.	174 (39.5)	111 (25.2)	2.850 (1.901–4.274)
	26–50	0 (0)	0 (0)	11 (2.5)	59 (13.4)	7 (1.6)	0 (0)	n.s.	33 (7.5)	44 (10.0)	0.639 (0.390–1.047)
	51–75	0 (0)	0 (0)	4 (0.9)	19 (4.3)	8 (1.8)	0 (0)	n.s.	12 (2.7)	19 (4.3)	0.559 (0.268–1.165)
	76–100	0 (0)	0 (0)	3 (0.7)	16 (3.6)	1 (0.2)	0 (0)	n.s.	2 (0.5)	18 (4.1)	0.094 (0.024–0.372)
	> 100	1 (0.2)	0 (0)	5 (1.1)	18 (4.1)	3 (0.7)	0 (0)	n.s.	8 (1.8)	19 (4.3)	0.366 (0.160–0.837)
Percentage of LRHC	< 25%	2 (0.5)	3 (0.7)	14 (3.2)	148 (33.6)	51 (11.6)	3 (0.7)	n.s.	151 (34.3)	70 (15.9)	3.889 (2.626–5.790)
	25–49%	1 (0.2)	0 (0)	8 (1.8)	48 (10.9)	12 (2.7)	0 (0)	n.s.	30 (6.8)	39 (8.9)	0.665 (0.398–1.112)
	50–75%	0 (0)	0 (0)	4 (0.9)	31 (7.0)	12 (2.7)	0 (0)	n.s.	23 (5.2)	24 (5.5)	0.870 (0.478–1.583)
	> 75%	0 (0)	0 (0)	4 (0.9)	31 (7.0)	12 (2.7)	0 (0)	0.006	25 (5.7)	78 (17.7)	0.209 (0.127–0.344)

Table 3 (continued)

Regions	Ports						p	Drain tube		OR (95% CI)
	Single	2 ports	3 ports	4 ports	5 ports	≥6 ports		Yes	No	
	(*n* = 3)	(*n* = 3)	(*n* = 48)	(*n* = 299)	(*n* = 84)	(*n* = 3)		(*n* = 229)	(*n* = 211)	
Africa	0 (0)	0 (0)	0 (0)	9 (2.0)	5 (1.1)	0 (0)	n.s.	4 (0.9)	10 (2.3)	0.357 (0.117–1.096)
Europe	1 (0.2)	0 (0)	18 (4.1)	132 (30.0)	19 (4.3)	0 (0)	n.s.	82 (18.6)	88 (20.0)	0.780 (0.531–1.145)
Mediterranean	0 (0)	0 (0)	5 (1.1)	38 (8.6)	14 (3.2)	0 (0)	n.s.	40 (9.1)	17 (3.9)	2.415 (1.331–4.378)
South-East Asia	0 (0)	0 (0)	2 (0.5)	18 (4.1)	6 (1.4)	0 (0)	n.s.	12 (2.7)	14 (3.2)	0.778 (0.357-1.695)
the Americas	2 (0.5)	3 (0.7)	20 (4.5)	96 (21.8)	27 (6.1)	2 (0.5)	n.s.	77 (17.5)	73 (16.6)	0.958 (0.646-1.420)
Western Pacific	0 (0)	0 (0)	3 (0.7)	5 (1.1)	12 (2.7)	1 (0.2)	4.0E−5	12 (2.7)	9 (2.0)	1.241 (0.524-2.937)

+ = adjusted residual > 1.96; - = adjusted residual < − 1.96

OR odds ratio, CI confidence intervals

evaluate the perioperative management and surgical strategy for a LRHC.

Several relevant topics have been evaluated. They showed similarities and differences among geographical regions.

LRHC can be a challenging procedure because of anatomical complexity and numerous variations [5, 6]. Several approaches have been described including vessel-first (medial-to-lateral) approaches, inferior (lateral-to-medial) approaches, and superior (lateral-to-medial) approaches [10, 11].

In this survey, the most commonly used approach was the vessel-first (medial-to-lateral) approach (74.1%). A systematic review and meta-analysis comparing the three approaches by Li et al. [12] showed that the postoperative recovery time and hospitalization time of the inferior approach group was shorter than the medial, vessel-first approach group and superior approach group. In this study, the influence of the type of approach on oncological outcomes was not assessed. To date, there is no consensus on the approach of preference.

Almost all respondents ($n=437$, 99%) routinely use multiple ports during a laparoscopic right hemicolectomy. There were several randomized controlled trials (RCTs) studying single-incision laparoscopic versus multiport laparoscopic colectomy [13–16]. The RCT by Poon et al. [14] showed that single-incision laparoscopic colectomy was associated with reduced postoperative pain and a shorter hospital stay. However, this study included only 50 patients. In 2016, Watanabe et al. performed a randomized clinical trial, including 200 patients undergoing a single-incision or a multiport LRHC [15]. Except for a significantly smaller incision, this study showed no advantage from a single-incision approach in comparison to a multiport LRHC. Additionally, in 2018, a multicenter, double-blinded, randomized controlled trial comparing single-incision with multiport laparoscopic colectomy was published by Moggiori et al. [16] who also concluded that single-incision laparoscopic colectomy had no additional benefit except for cosmetic results. Kim et al. studied a three-port LRHC versus a five-port LRHC for colon cancer [17]. They showed that a three-port LRHC was associated with a shorter operating time due to the reduced trocar insertion and trocar ports closure times. However, it was a retrospective study with a small sample size including 163 patients. To date, there is no consensus on the optimal number of ports for LHRC. However, based on the aforementioned data, the number of ports does not seem to significantly alter clinical outcomes.

Regardless of the regions, number of performed cases, years of experience, and institutes, the majority of respondents (68.6%) stated that they perform an extracorporeal anastomosis. There are several studies comparing extracorporeal anastomosis with intracorporeal anastomosis [18–23]. A recently published meta-analysis including

Table 4 Data related to the preoperative management

		Bowel preparation		
		Yes ($n=267$)	No ($n=173$)	OR (95% CI)
Age	20–29 years old	15 (3.4)	4 (0.9)	2.515 (0.860–7.331)
	30–39 years old	63 (14.3)	56 (12.7)	0.645 (0.422–0.986)
	40–49 years old	89 (20.2)	54 (12.3)	1.102 (0.732–1.659)
	50–59 years old	63 (14.3)	40 (9.1)	1.027 (0.654–1.611)
	60 years old or above	37 (8.4)	19 (4.3)	1.304 (0.727–2.337)
Experience (years)	< 5 years	57 (13.0)	30 (6.8)	1.303 (0.800–2.121)
	5–10 years	56 (12.7)	48 (10.9)	0.691 (0.444–1.076)
	11–15 years	60 (13.6)	40 (9.1)	0.964 (0.612–1.517)
	16 years above	94 (21.4)	55 (12.5)	1.166 (0.777–1.749)
Experience (cases)	0–25 cases	186 (42.3)	99 (22.5)	1.716 (1.153–2.555)
	26–50 cases	39 (8.9)	38 (8.6)	0.608 (0.371–0.994)
	51–75 cases	18 (4.1)	13 (3.0)	0.890 (0.430–1.841)
	76–100 cases	9 (2.0)	11 (2.5)	0.514 (0.214–1.236)
	> 100 cases	15 (3.4)	12 (2.7)	0.799 (0.370–1.722)
Percentage of LRHC	< 25%	157 (35.7)	64 (14.5)	2.431 (1.642–3.599)
	25–49%	36 (8.2)	33 (7.5)	0.661 (0.396–1.105)
	50–75%	21 (4.8)	26 (5.9)	0.483 (0.264–0.883)
	> 75%	53 (12.0)	50 (11.4)	0.609 (0.391–0.950)
Regions	Africa	8 (1.8)	6 (1.4)	0.860 (0.306–2.415)
	Europe	95 (21.6)	75 (17.0)	0.722 (0.488–1.067)
	Mediterranean	36 (8.2)	21 (4.8)	1.128 (0.638–1.995)
	South-East Asia	20 (4.5)	6 (1.4)	2.254 (0.911–5.565)
	The Americas	90 (20.5)	60 (13.6)	0.958 (0.641–1.431)
	Western Pacific	16 (3.6)	5 (1.1)	2.142 (0.798–5.733)

		Preoperative antibiotics				
		Both oral and intravenous ($n=43$)	Intravenous ($n=372$)	Oral ($n=18$)	No ($n=7$)	p value
Age	20–29 years old	2 (0.5)	13 (3.0)	1 (0.2)	3 (0.7)$^{+}$	0.003
	30–39 years old	10 (2.3)	102 (23.2)	6 (1.4)	1 (0.2)	
	40–49 years old	15 (3.4)	120 (27.3)	5 (1.1)	3 (0.7)	
	50–59 years old	11 (2.5)	89 (20.2)	3 (0.7)	0 (0)	
	60 years old or above	5 (1.1)	48 (10.9)	3 (0.7)	0 (0)	
Experience (years)	< 5 years	9 (2.0)	68 (15.5)	7 (1.6)	3 (0.7)	n.s
	5–10 years	7 (1.6)	94 (21.4)	1 (0.2)	2 (0.5)	
	11–15 years	13 (3.0)	84 (19.1)	3 (0.7)	0 (0)	
	16 years above	14 (3.2)	126 (28.6)	7 (1.6)	2 (0.5)	
Experience (cases)	0–25 cases	21 (4.8)	245 (55.7)	14 (3.2)	5 (1.1)	n.s
	26–50 cases	12 (2.7)	61 (13.9)	3 (0.2)	1 (0.2)	
	51–75 cases	2 (0.5)	27 (6.1)	1 (0.2)	1 (0.2)	
	76–100 cases	3 (0.7)	17 (3.9)	0 (0)	0 (0)	
	> 100 cases	5 (1.1)	22 (5.0)	0 (0)	0 (0)	
Percentage of LRHC	< 25%	20 (4.5)	185 (42.0)	11 (2.5)	5 (1.1)	n.s
	25–49%	11 (2.5)	55 (12.5)	2 (0.5)	1 (0.2)	
	50–75%	3 (0.7)	42 (9.5)	2 (0.5)	0 (0)	
	> 75%	9 (2.0)	90 (20.5)	3 (0.7)	1 (0.2)	
Regions	Africa	0 (0)	13 (3.0)	0 (0)	1 (0.2)	n.s
	Europe	23 (5.2)	137 (31.1)	7 (1.6)	3 (0.7)	
	Mediterranean	4 (0.9)	50 (11.4)	2 (0.5)	1 (0.2)	
	South-East Asia	0 (0)	25 (5.7)	1 (0.2)	0 (0)	
	The Americas	15 (3.4)	125 (28.4)	8 (1.8)	2 (0.5)	
	Western Pacific	1 (0.2)	20 (4.5)	0 (0)	0 (0)	

Table 4 (continued)

+ = adjusted residual > 1.96; − = adjusted residual < − 1.96

OR odds ratio, *CI* confidence intervals

4450 patients showed that intracorporeal anastomoses are associated with smaller extraction site incisions, earlier bowel recovery, fewer complications, and lower rates of conversion, surgical site infections, anastomotic leakage, and incisional hernia in comparison to the extracorporeal anastomosis [24]. However, many of the included studies have a short-term follow-up and remain unclear with regards to both groups for oncological outcomes.

Over half of the respondents to this survey stated that they perform a midline incision (53%) and the remaining a Pfannenstiel's incision (47%) for specimen extraction. There were no statistically significant differences regarding the surgeons' age, number of performed cases, years of experience, and surgical institutes. However, a statistically significant correlation was found between the type of the anastomosis made and the extraction site of the specimen in which surgeons who perform an intracorporeal anastomosis were more likely to use a Pfannenstiel's incision as an extraction site, while surgeons who perform an extracorporeal anastomosis were more likely to use a midline incision as an extraction site. This correlation can be explained by the fact that an extracorporeal ileotransversostomy is generally easier to perform through a midline incision since a Pfannenstiel's incision would require a more extensive bowel mobilization. Benlice et al. [25] reported that an extraction site off the midline was associated with a low risk of wound infection and several other studies showed that a midline incision had a higher incisional hernia rate in comparison to a Pfannenstiel's incision [26–29].

In this survey, although the findings of several studies show that a routine abdominal drain tube placement has no benefit in colorectal surgery [30–33], over 50% of respondents routinely use it. Of these respondents, the majority work at a surgical institute with < 25% of the total number of right hemicolectomies performed laparoscopically (50.3%). Subdivided by region, Eastern Mediterranean respondents are the most frequent users of abdominal drain tubes. In this region, the proportion of respondents with < 25% of the total number of right hemicolectomies performed laparoscopically was relatively higher as compared to other regions (74%, ASR: 5.02). In addition, surgeons working at institutions with a small percentage of LRHC and surgeons with a low number of performed LRHC cases tend to routinely use an abdominal drain tube. As a result, the low number of laparoscopic cases and the limited laparoscopic experience of surgeons may be a predicting factor for routine drain tube placement.

Enhanced Recovery After Surgery (ERAS), the American Society of Colon and Rectal Surgeons (ASCRS), and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) guidelines do not recommend the routine use of abdominal drain tubes following colonic surgery [7, 8]. A recently published propensity score-matched study on LRHC postoperative outcomes, including 653 patients, showed that the use of an abdominal drain tube has no benefit for the patient [34]. Additionally, several studies have even reported that the use of abdominal drains has been associated with drain-related complications and skin ulcers [12].

Colorectal surgery has a higher incidence of surgical site infections (SSI) than other gastrointestinal surgeries, with an SSI incidence of up to 30 to 40% without prophylactic antibiotics [35]. In 2019, a meta-analysis including a total of 40 studies with 69,517 patients showed that mechanical and oral antibiotic bowel preparation (MOABP) was associated with a reduced risk of SSI, anastomotic leak rates, 30-day mortality, overall morbidity, and the incidence of postoperative ileus, without increasing the risk of developing Clostridium difficile infection [36]. On the other hand, Koskenvuo et al. reported a first multicenter, randomized, parallel, single-blinded trial comparing mechanical bowel preparation (MBP) with MOABP in 2019. They showed that MOABP did not reduce the occurrence of SSI as compared to no bowel preparation after colonic surgery [37]. In the current survey, bowel preparation was routinely used by 60.7% of respondents ($n = 267$). Only 10.7% of them answered that they used it together with taking oral antibiotics (Table 6). The ERAS, ASCRS, and SAGES guidelines do not recommend the solitary use of mechanical bowel preparation (MBP) in colonic surgery and provide a weak recommendation to the routine use of MOABP [7, 8].

The WHO guidelines do not recommend the prolongation of prophylactic antibiotics after the operation for the purpose of preventing SSI [38]. The ERAS guideline recommends a single-dose intravenous antibiotic prophylaxis within 60 min before the incision and shows that multiple doses have no additional benefits [8]. In addition, several guidelines recommend to discontinue antibiotic prophylaxis within 24 h after surgery. A multicenter, randomized trial by Fujita et al., including a total of 384 patients, showed that two additional doses every 8 h after the first dose just before skin incision was more effective for the prevention of SSI than a single-dose antibiotic [39]. Based on the above considerations, there is no consensus on whether to administer a prophylactic single dose or multiple doses. However,

Table 5 Data related to the postoperative management

		Post-antibiotics		
		Yes ($n=246$)	No ($n=194$)	OR (95% CI)
Age	20–29 years old	13 (3.0)	6 (1.4)	1.748 (0.673–4.530)
	30–39 years old	60 (13.6)	59 (13.4)	0.738 (0.485–1.124)
	40–49 years old	81 (18.4)	62 (14.1)	1.045 (0.700–1.561)
	50–59 years old	62 (14.1)	41 (9.3)	1.257 (0.804–1.966)
	60 years old or above	30 (6.8)	26 (5.9)	0.897 (0.514–1.567)
Experience (years)	< 5 years	53 (12.0)	34 (7.7)	1.292 (0.802–2.081)
	5–10 years	56 (12.7)	48 (10.9)	0.896 (0.577–1.392)
	11–15 years	56 (12.7)	44 (10.0)	1.005 (0.642–1.572)
	16 years above	81 (18.4)	68 (15.5)	0.910 (0.612–1.352)
Experience (cases)	0–25 cases	183 (41.6)	102 (23.2)	2.620 (1.755–3.921)
	26–50 cases	33 (7.5)	44 (10.0)	0.528 (0.322–0.866)
	51–75 cases	16 (3.6)	15 (3.4)	0.830 (0.405–1.703)
	76–100 cases	5 (1.1)	15 (3.4)	0.248 (0.092–0.669)
	> 100 cases	9 (2.0)	18 (4.1)	0.371 (0.166–0.831)
Percentage of LRHC	< 25%	168 (38.2)	53 (12.0)	5.730 (3.789–8.666)
	25–49%	34 (7.7)	35 (8.0)	0.729 (0.437–1.215)
	50–75%	20 (4.5)	27 (6.1)	0.547 (0.299–1.003)
	> 75%	24 (5.5)	79 (18.0)	0.157 (0.095–0.261)
Regions	Africa	10 (2.3)	4 (0.9)	2.013 (0.656–6.158)
	Europe	59 (13.4)	111 (25.2)	0.236 (0.157–0.355)
	Mediterranean	45 (10.2)	12 (2.7)	3.396 (1.758–6.552)
	South–East Asia	24 (5.5)	2 (0.5)	10.378 (2.679–40.070)
	The Americas	92 (20.9)	58 (13.2)	1.401 (0.938–2.091)
	Western Pacific	14 (3.2)	7 (1.6)	1.612 (0.655–3.962)

		Oral intake					
		POD 0 ($n=36$)	POD 1 ($n=102$)	POD 2 ($n=130$)	POD 3 ($n=116$)	≥·POD 4 ($n=56$)	p value
Age	20–29 years old	0 (0)	5 (1.1)	9 (2.0)	3 (0.7)	2 (0.5)	n.s
	30–39 years old	12 (2.7)	27 (6.1)	34 (7.7)	31 (7.0)	15 (3.4)	
	40–49 years old	13 (3.0)	32 (7.3)	41 (9.3)	36 (8.2)	21 (4.8)	
	50–59 years old	6 (1.4)	24 (5.5)	32 (7.3)	30 (6.8)	11 (2.5)	
	60 years old or above	5 (1.1)	14 (3.2)	14 (3.2)	16 (3.6)	7 (1.6)	
Experience (years)	< 5 years	4 (0.9)	19 (4.3)	30 (6.8)	24 (5.5)	10 (2.3)	n.s
	5–10 years	11 (2.5)	21 (4.8)	29 (6.6)	27 (6.1)	16 (3.6)	
	11–15 years	11 (2.5)	19 (4.3)	32 (7.3)	27 (6.1)	11 (2.5)	
	16 years above	10 (2.3)	43 (9.8)	39 (8.9)	38 (8.6)	19 (4.3)	
Experience (cases)	0–25 cases	12 (2.7)$^{-}$	58 (13.2)	92 (20.9)	82 (18.6)	41 (9.3)	6.64E−04
	26–50 cases	6 (1.4)	21 (4.8)	20 (4.5)	22 (5.0)	8 (1.8)	
	51–75 cases	7 (1.6)$^{+}$	9 (2.0)	7 (1.6)	6 (1.4)	2 (0.5)	
	76–100 cases	5 (1.1)$^{+}$	5 (1.1)	5 (1.1)	4 (0.9)	1 (0.2)	
	> 100 cases	6 (1.4)$^{+}$	9 (2.0)	6 (1.4)	2 (0.5)$^{-}$	4 (0.9)	
Percentage of LRHC	< 25%	5 (1.1)$^{-}$	39 (8.9)$^{-}$	69 (15.7)	72 (16.4)$^{+}$	36 (8.2)	3.72E−08
	25–49%	5 (1.1)	24 (5.5)$^{+}$	20 (4.5)	15 (3.4)	5 (1.1)	
	50–75%	3 (0.7)	10 (2.3)	16 (3.6)	14 (3.2)	4 (0.9)	
	> 75%	23 (5.2)$^{+}$	29 (6.6)	25 (5.7)	15 (3.4)$^{-}$	11 (2.5)	
Regions	Africa	1 (0.2)	2 (0.5)	3 (0.7)	5 (1.1)	3 (0.7)	0.001
	Europe	25 (5.7)$^{+}$	43 (9.8)	54 (12.3)	36 (8.2)	12 (2.7)$^{-}$	
	Mediterranean	2 (0.5)	8 (1.8)	19 (4.3)	15 (3.4)	13 (3.0)$^{+}$	
	South-East Asia	0 (0)	2 (0.5)$^{-}$	6 (1.4)	13 (3.0)$^{+}$	5 (1.1)	
	The Americas	6 (1.4)	44 (10.0)$^{+}$	43 (9.8)	38 (8.6)	19 (4.3)	
	Western Pacific	2 (0.5)	2 (0.5)	5 (1.1)	9 (2.0)$^{+}$	3 (0.7)	

Table 5 (continued)

+ = adjusted residual > 1.96;— = adjusted residual < − 1.96

OR odds ratio, *CI* confidence intervals

Table 6 Correlations between preoperative antibiotics and bowel preparation

Bowel preparation	Preoperative antibiotics			No	Total
	Oral and intravenous	Oral	Intravenous		
Yes	34 (7.7)	13 (3.0)	215 (48.9)	5 (1.1)	267 (60.7)
No	9 (2.0)	5 (1.1)	157 (35.7)	2 (0.5)	173 (39.3)
Total	43 (9.8)	18 (4.1)	372 (84.5)	7 (1.6)	440

the prolongation of antibiotic prophylaxis may contribute to the emergence of resistant bacteria, side effects related to antibiotic administration and increased costs. Consequently, the prolongation of antibiotic prophylaxis should be avoided.

Respondents who have more LRHC experience were more likely to allow for the resumption of early oral intake. However, an unnegligible percentage of respondents (12.7%) allow their patients to have a solid diet only after postoperative day 4. The ERAS, ASCRS, and SAGES recommend an early resumption of oral intake based on several studies which showed that early resumption of oral intake accelerated recovery and decreased hospital length of stay, the rate of complications, mortality, and overall hospital costs [40–47]. The ideal feeding time after laparoscopic right hemicolectomy is not well-established. However, it is well-established that the delay in resuming oral intake after surgery results in disadvantages for patients, such as an increased incidence of infectious complications and delayed recovery [7, 48].

Although this survey has provided several valuable insights into the current global practice with regards to LRHC, some limitations need to be addressed.

Since respondents to this survey were approached through e-mail and through open invitations on various social media, the response rate cannot be calculated.

The uneven distribution of responding surgeons among the geographical regions as well as the uneven distribution of age and years of experience may have influenced the results of this survey. Some subgroups were too small in size, which did not allow to make a comparative analysis with other groups. Additionally, since this survey was addressed to surgeons who perform colorectal surgery, and considering the age distributions, it cannot be ruled out that some respondents were not qualified surgeons yet, but rather surgical residents who are at the beginning of their learning curve, and that not all respondents are specialized colorectal surgeons, but rather general surgeons who perform colorectal surgery, which might partly explain the discrepancy of the results of this survey as compared to current best practices and guidelines.

Finally, since this is not a validated questionnaire, we cannot state with certainty that all respondents have fully understood the questions.

However, despite these limitations, we believe that this large international survey has provided valuable information and insights into current practices with regards to LRHC and the (in)compatibility with the data derived from some pivotal RCTs and guidelines.

Due to the COVID-19 pandemic and the enhanced use of online educational systems for surgeons to improve their skills and knowledge, we were in the unique situation to be able to directly discuss the issues evaluated in the survey during the webinar on LRHC which was broadcasted live through the IRCAD website and which was attended by 1219 participants from 105 countries (this webinar can be seen through this link: http://websurg.com/doi/oc01en6000). We believe that such, online and freely accessible initiatives may help in improving the establishment of evidence-based medicine throughout the global surgical communities.

Conclusion

This is one of the largest international surveys on perioperative management and surgical procedures applied for LRHC. Regarding several topics related to LRHC care, a discrepancy was observed between the current medical practice and the recommendations from RCTs and international guidelines.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00464-022-09044-w.

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Declarations

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