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Single port versus standard laparoscopic right colectomies: results of a case–control retrospective study on one hundred patients

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1. Introduction

Several prospective, multicenter, randomized clinical trials [1–3] and subsequent meta-analyses [4,5] have clearly demonstrated the safety, superiority regarding short-term outcomes and non-inferiority regarding oncological results and long-term outcomes of laparoscopic surgery as treatment for colonic malignancies in comparison to open surgery. During the last few years, in attempts to reduce the surgical trauma, new surgical approaches to the abdominal cavity have been proposed. Among them, single-port laparoscopic surgery is gaining great attention and is being widely adopted in many centers, even for the treatment of different colorectal diseases. However, while safety and feasibility have already been proved by small series [6,7] and case–control studies, [8–12] there is still a need to compare single-port with the conventional multi-port laparoscopic approach and hence to demonstrate possible advantages.

The aim of this study is to retrospectively compare results from a consecutive series of 50 cases of single-port right colectomies with 50 cases of standard laparoscopic right colectomies performed in the same center by the same surgeon (LB).

2. Patients and Methods

Fifty patients who underwent single-port (SP) laparoscopic right colectomy, either for benign polyps not suitable for endoscopic resection or for malignant tumors, were retrospectively compared with 50 cases of standard multi-port (MP) laparoscopic right colectomy performed by the same surgeon (LB) at the Department of Surgery of the University of Insubria in Varese (Italy). SP laparoscopic right colectomies were performed using a specifically designed single-port access system using both standard and co-axially curved instruments (Endocone™, Karl Storz GmbH, Tuttlingen, Germany) and according to a standardized technique previously described. [13] The SP group was composed of the first 50 SP laparoscopic right colectomies which were performed for colon tumors (benign or malignant) by LB, who has extensive experience with SP laparoscopic procedures, while the MP group was composed of the last 50 MP laparoscopic right colectomies performed by the same surgeon at the same institution. Exclusion criteria were general contraindications to laparoscopic surgery and, in the case of the SP approach, the presence of a tumor with an estimated diameter (according to pre-operative imaging findings) greater than 3.5 cm, namely the width of the surgical incision necessary for introduction of the SP device. Patients were not randomized; instead, after the absence of contraindications was verified and specific informed consent was obtained, each patient had the chance to choose the type of approach.

Post-operative management policies were the same for both groups and all patients were cared for in the same surgical department. The need to perform transfusions of blood components, in particular, was based on the hemoglobin level, comorbidities and general clinical status of the patient.

2.1. Statistical analysis

Depending on the possibility of using a parametric test and on the nature (qualitative vs quantitative) of the data to be analyzed,

three different types of tests were used: chi-squared test (parametric test for qualitative data), Fisher's exact test (non-parametric test for qualitative data) or Mann–Whitney test (non-parametric test for quantitative data). It was never possible to use a parametric test for quantitative data. Analyses were performed with R software (R Foundation, http://www.r-project.org).

3. Results

Results are summarized in Table 1. The two groups differed neither in demographical characteristics, even though a higher percentage of women was present in the SP group, nor in past surgical history. They also had similar body mass index (data not shown).

Every patient underwent right colectomy, except 5 out of 50 patients in the MP group who, due to involvement of the transverse colon, had an extended right colectomy.

Perioperative outcomes were not significantly different between the two groups and in particular operative times were comparable (median time: 160 minutes for the SP group vs 152 minutes for the MP group). However, in the SP group there was a significant reduction in the proportion of patients (4% vs 26%) who needed transfusion of blood components.

There was no significant difference in oncological results: margin status was negative for every patient, the number of lymph nodes retrieved in the surgical specimen was very similar, and the proportion of patients for whom an adequate number of lymph nodes (at least 12) had been harvested did not differ significantly (100% in the SP group vs 92% in the MP group).

There were no differences also from the pathological standpoint (presence of adenoma and/or adenocarcinoma, and, in the case of malignant tumor, pathological stage, overall and in any single variable, namely T, N, and M), even though the MP group seemed to be characterized by less differentiated tumors (individual p-value 0.03).

However, as far as postoperative outcomes are concerned, there were many significant differences favoring the SP group over the MP group: a more rapid recovery of bowel function, with a faster return to a solid diet (on second postoperative day vs fourth postoperative day, $p < 0.0001$) and a shorter hospital stay (6 days vs 8 days, $p < 0.0001$). The difference regarding postoperative complications ($p = 0.05$) pointed to a smaller number of complications in the SP group.

4. Discussion

Over the past few years, in the quest for reduction of surgical trauma and residual scarring to the patients, alternative techniques to standard laparoscopic surgery have been proposed.

Among them, single-port surgery has been fairly accepted by the surgical community thanks to some practical advantages such as limited need for modification of standard technique, possibility to perform different kinds of procedures from simple cholecystectomy to more complex operations and minimal technological requirements.

The use of minimally invasive surgery for the treatment of different colonic diseases including cancer has been fully validated by several multicenter randomized trial performed on different continents [1–3] and it is now worldwide considered a valid alternative to open surgery, able to achieve better results in terms of reduction of post-operative stay and wound-related complications, without compromising the oncological results.

While such results on standard laparoscopic colonic resection are nowadays accepted, to date there are no data regarding the effect of single-port surgery on colorectal resection. So far only small series or case reports have been reported in the literature.

Recently Chen et al. [12] described their results in a case–control retrospective study on 18 plus 21 patients finding no difference between single-port and multi-port surgery.

In our study we did find few, limited but significant benefits for the SP group versus MP in terms of return to solid diet, post-operative stay, post-operative transfusion and overall post-operative complications, without any differences in term of lymph node harvesting and surgical margins.

These results are quite surprising although they might be related to the lack of patient randomization. Our study, in fact, is not a prospective randomized trial and the case group (SP group) and the control group (MP group) were matched according to the indication for the surgical procedure, namely the presence of adenomas not suitable for endoscopic resection and/or adenocarcinomas of the right colon, because we wished to validate the SP approach for an oncological procedure. As already stated, provided that general contraindications to laparoscopic surgery were not present, the type of approach was chosen according to the estimated tumor diameter at pre-operative CT scan (less than 3.5 cm for the SP group). In order to eliminate unwanted and confusing influences on part of factors that could be controlled, we opted for the following:

- only patients with colon tumors (benign and/or malignant) were enrolled;
- every tumor was in the right colon, and hence the same procedure, namely right colectomy (except for 5 out of 50 patients in the MP group who, due to involvement of the transverse colon, had an extended right colectomy), was performed in every patient;
- every procedure was carried out at the same institution and by the same operator, who has a wide expertise in minimally invasive surgery and also with SP laparoscopic interventions;
- for the SP procedures, we always used the same device (Endocone™) and followed the same operative steps.

However, despite our intention of having two groups of patients as homogeneous as possible, we were not able to match them for every characteristic. This may retrospectively explain, at least in part, the (almost significant) differences that we observed in the gender distribution of the two groups and the various grades of differentiation of the resected adenocarcinomas. However, it is worthwhile to underscore that the grade of differentiation is mainly a factor intended to stratify patients in different prognostic classes in the long run and hence has a very limited role when dealing with the oncological accuracy of the SP vs the MP approach and short-term outcomes. Among the studies that deal with this topic (SP vs MP laparoscopic approach for colon tumors) and that have been published to date, [9–13] our study enrolled the highest number of patients (100 patients overall) and has therefore the highest statistical power.

Of course, a randomized prospective trial would be needed to definitely address this topic.

5. Conclusions

This case–control study compared the single-port laparoscopic approach with the conventional multi-port laparoscopic approach for right colectomies performed in patients with colonic adenomas not suitable for endoscopic resection and/or adenocarcinomas.

The single-port laparoscopic approach was not inferior to the multi-port approach with respect to oncological and short-term outcomes. Moreover, it was associated with a reduction in the proportion of patients needing transfusion of blood components, a more rapid return to a solid diet and a shorter hospital stay (6 days vs 8 days).

Table 1
Results

	All patients	Laparoscopic approach		p-value [a]
		Single-port	Multi-port	
Demographic characteristics				
No. of patients	100	50	50	
Age, years				
Median	65	65	65	0.65 [b]
Range	36–88	36–88	44–87	
Gender, no. (%)				
Male	43 (43)	17 (34)	26 (52)	0.07 [c]
Female	57 (57)	33 (66)	24 (48)	
Past surgical history				
Previous abdominal surgical procedures, no. (%)				
0	48 (48)	25 (50)	23 (46)	0.13 [c]
1	42 (42)	23 (46)	19 (38)	
⩾2	10 (10)	2 (4)	8 (16)	
Perioperative outcomes				
Type of resection, no. (%)				
Right colectomy	95 (95)	50 (100)	45 (90)	0.06 [d]
Extended right colectomy	5 (5)	0 (0)	5 (10)	
Conversion, no. (%)				
No	98 (98)	50 (100)	48 (96)	0.48 [d]
Conversion to hand-assisted	1 (1)	0 (0)	1 (2)	
Conversion to open	1 (1)	0 (0)	1 (2)	
Operative time, min				
Median	156	160	152	0.17 [b]
Range	110–215	115–210	110–215	
Transfusion of blood components, no. (%)				
No	85 (85)	48 (96)	37 (74)	**0.002** [c]
Yes	15 (15)	2 (4)	13 (26)	
Perioperative variation in hemoglobin concentration				
Median	−7	−7	−7	0.52 [b]
Range	−7 to +33	−7 to +18	−29 to +33	
Oncological results				
Margin status, no. (%)				
Negative, R0	100 (100)	50 (100)	50 (100)	1 [d]
Positive	0 (0)	0 (0)	0 (0)	
No. of lymph nodes harvested				
Median	21	21	22	0.34 [b]
Range	8–38	13–34	8–38	
Adequate lymphadenectomy (at least 12 lymph nodes harvested), no. (%)				
Yes	96 (96)	50 (100)	46 (92)	0.12 [d]
No	4 (4)	0 (0)	4 (8)	
Adenoma and/or adenocarcinoma				
Histological report, no. (%)				
Adenoma only	14 (14)	8 (16)	6 (12)	0.24 [d]
Adenocarcinoma only	83 (83)	42 (84)	41 (82)	
Adenoma plus adenocarcinoma	3 (3)	0 (0)	3 (6)	
Pathological stage (only patients with adenocarcinoma)				
No. of patients	86	42	44	
T, no. (%)				
T1	10 (12)	6 (14)	4 (9)	0.73 [d]
T2	17 (20)	7 (17)	10 (23)	
T3	54 (63)	26 (62)	28 (64)	
T4	5 (6)	3 (7)	2 (5)	

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Table 1
(*continued*)

	All patients	Laparoscopic approach		p-value [a]
		Single-port	Multi-port	
N, no. (%)				
N0	43 (50)	23 (55)	20 (45)	0.68 [c]
N1	21 (24)	9 (21)	12 (27)	
N2	22 (26)	10 (24)	12 (27)	
M, no (%)				
M0	72 (84)	36 (86)	36 (82)	0.62 [c]
M1	14 (16)	6 (14)	8 (18)	
TNM stage, no. (%)				
I	15 (17)	7 (17)	8 (18)	0.95 [c]
II	25 (29)	13 (31)	12 (27)	
III	32 (37)	16 (38)	16 (36)	
IV	14 (16)	6 (14)	8 (18)	
Grade of differentiation (only patients with adenocarcinoma)				
No. of patients	86	42	44	
G, no. (%)				
G1 (well differentiated)	24 (28)	17 (40)	7 (16)	**0.03** [c]
G2 (moderately differentiated)	52 (60)	22 (52)	30 (68)	
G3 (poorly differentiated)	10 (12)	3 (7)	7 (16)	
Postoperative outcomes				
Return to solid diet on POD [e]				
Median	3	2	4	**<0.0001** [b]
Range	1–10	1–6	2–10	
Duration of hospitalization, days				
Median	7	6	8	**<0.0001** [b]
Range	4–34	4–16	4–34	
Complications/death, no. (%)				
None	84 (84)	46 (92)	38 (76)	**0.05** [d]
Temporary (no more present at discharge)	15 (15)	4 (8)	11 (22)	
Fatal during hospital stay	1 (1)	0 (0)	1 (2)	

[a] p-values in boldface type indicate significance.
[b] Mann–Whitney test. [c] χ^2 test (chi-squared test). [d] Fisher's exact test.
[e] POD, postoperative day.

Therefore, the single-port laparoscopic approach, even though technically more demanding and requiring more dexterity on part of the operator due to its ergonomic limitations, could have a definite role in oncological colorectal surgery.

Prospective randomized clinical trials would be needed to confirm these findings.

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The authors have no conflicts of interest to declare.

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