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Single port laparoscopic ileocaecal resection for Crohn's disease: a multicentre comparison with multi-port laparoscopy

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Abstract

Aim Single port (SP) ileocaecal resection (ICR) is an established technique but there are no large studies comparing SP and multi-port (MP) laparoscopic surgery in Crohn's disease (CD). The aim of this study was to compare postoperative pain scores and analgesia requirements after SP and MP laparoscopic ICR for CD.

Method This was a retrospective study of patients undergoing SP or MP ICR for CD in three tertiary referral centres from February 1999 to October 2014. Baseline characteristics (age, sex, body mass index and indication for surgery) were compared. Primary endpoints were postoperative pain scores, analgesia requirements and short-term postoperative outcomes.

Results SP ICR ($n = 101$) and MP ICR ($n = 156$) patients were included in the study. Visual analogue scale scores were significantly lower after SP ICR on postoperative day 1 ($P = 0.016$) and day 2 ($P = 0.04$). Analgesia requirements were significantly reduced on postoperative day 2 in the SP group compared with the MP group ($P = 0.007$). Duration of surgery, conversion to open surgery and stoma rates were comparable between the two groups. Surgery was more complex in terms of additional procedures when MP was adopted ($P = 0.001$). There were no differences in postoperative complication rates, postoperative food intake, length of stay and readmissions.

Conclusion These data suggest that in comparison to standard laparoscopic surgery SP ICR might be less painful and patients might require less opioid analgesia.

Keywords SILS, Crohn's disease, laparoscopy

What does this paper add to the literature?
This multicentre study involving a large number of patients with ileocaecal Crohn's disease demonstrates that single port ileocolic resection for Crohn's disease is associated with less pain and a reduction in analgesia compared with multi-port ileocolic resection.

Introduction

Laparoscopy is considered the preferred approach for ileocaecal Crohn's disease (CD) because there are benefits in terms of short- and long-term morbidity [1–4]. Single port (SP) surgery allows the entire procedure to be performed, laparoscopically, using just one incision which also serves as the extraction site [5]. The approach reduces the number of surgical port sites and produces even better cosmetic results [6]. Reducing the number of ports may also reduce postoperative pain [7–9]. The feasibility of SP surgery in inflammatory bowel disease (IBD) has been addressed in a limited number of studies whilst SP has only been compared with multi-port (MP) in series with limited numbers [8,10–13].

The aim of this study was to compare short-term outcomes in a large cohort of patients undergoing ileocaecal resection (ICR) for sometimes complex ileocolic CD utilizing SP or MP laparoscopic surgical techniques.

Methods

Patient selection and surgeons' background

Adult CD patients from three European tertiary referral centres (Humanitas Clinical and Research Center,

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Milan, Italy; Academic Medical Center, Amsterdam, The Netherlands; and University Hospital Leuven, Leuven, Belgium) who underwent SP ICR from March 2010 to October 2014 were included in the present study. Consecutive SP ICR patients were compared with a historical cohort of patients undergoing MP ICR (1999–2012) selected from the same three centres. The surgeons conducting the operations were fully trained as colorectal/IBD surgeons and were also experienced laparoscopists.

End-points

The primary end-points of the study were postoperative pain scores and analgesia requirements after surgery. Medical records were reviewed for the following demographics: sex, age, body mass index, smoking status, preoperative medical therapy, duration of disease and indication (stricture, abscess, refractory disease, elective, emergency). Surgical details included duration of surgery, conversion to open or MP laparoscopic surgery, incision site and incision length, type of anastomosis, any associated surgical procedures, stoma creation and number of additional ports. Postoperative complications were defined as adverse events within 30 days following surgery and were assessed according to the Clavien–Dindo classification of surgical complications [14]. Furthermore, postoperative bowel movements, oral intake, length of hospital stay, postoperative pain, postoperative analgesia administration and hospital readmission were assessed.

Visual analogue scale (VAS) scores for postoperative pain were recorded on days 1, 2 and 3. In two of the three institutions involved in the study, the postoperative analgesia protocol was managed by intravenous morphine on demand (patient-controlled anaesthesia). Additional pain medication such as paracetamol and non-steroidal anti-inflammatory drugs were administered in order to maintain the VAS score below 4. In the third institution, the analgesia protocol included levobupivacaine plus sufentanil administered by patient-controlled epidural analgesia. Given that two different analgesia protocols were used and that the absolute number of different opioid drugs would not have been suitable for a conjunct analysis, the relative percentage reductions in drug dose on postoperative days 2 and 3 were calculated and compared with postoperative day 1.

Single port ileocaecal resection

SP ICR was performed using a Gel-point™ Advanced Access Platform (Applied Medical, Rancho Santa Margarita, California, USA) or a glove port positioned at the extraction site (umbilical or suprapubic). We used standard straight laparoscopic instruments. Mobilization of the ascending colon was performed either from lateral to medial or from medial to lateral. The ileocolic pedicle was divided either intracorporeally or extracorporeally after its exteriorization through the extraction site. The ileocolic anastomosis was performed extracorporeally. The placement of additional ports during an SP procedure was defined as conversion to the MP technique.

Multi-port ileocaecal resection

Up to four ports were used including the umbilical camera port. Mobilization of the right colon and the terminal ileum was performed from lateral to medial. The specimen was extracted through the umbilical incision by extending the umbilical port access or through a Pfannenstiel suprapubic incision in the case of a large inflammatory mass.

Statistical analysis

Continuous non-parametric data were presented as median and interquartile range (IQR), whereas nominal data were presented as percent frequency of occurrence. The Mann–Whitney *U*-test was used to compare non-parametric data. When expected frequencies were ≥ 5, the Pearson's chi-squared test was performed to compare proportions. The Fisher's exact test was used when the expected count was < 5. A P value of < 0.05 was considered statistically significant. Statistical analysis was performed using the Statistical Package for Social Science 17.0 (SPSS Inc., Chicago, Illinois, USA).

Results

Patient characteristics

One hundred and one consecutive patients underwent SP ICR and 156 patients underwent MP ICR. The baseline characteristics of the two groups of patients are presented in Table 1. The median age at time of surgery was 28 years (IQR 22–44) in the SP group and 30 years (IQR 23–40) in the MP group. No differences were found in terms of duration of disease, medical therapy prior to surgery or indication for surgery.

Surgical specifics

Surgical specifics are displayed in Table 2. Duration of surgery was comparable between the two groups, with median durations of 120 min (IQR 90–173) and

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Table 1 Baseline characteristics of included patients.

Baseline characteristics	SP	MP	*P* value
N	101	156	
Female (*N*, %)	64 (63)	95 (61)	0.691*
Age (years) at surgery (median, IQR)	28 (22–44)	30 (23–40)	0.706†
BMI (median, IQR)	22 (20–24)	22 (20–25)	0.490†
Smoking (*N*, %)	28 (28)	56 (36)	0.165*
Disease duration in months (median, IQR)	49 (18–94)	48 (15–98)	0.732†
Medical therapy prior to surgery (*N*, %)			
Steroids	16 (15.8)	36 (23.1)	0.354*
AZA/6MP/MTX	35 (34.7)	57 (36.5)	
Anti-TNF	32 (31.7)	44 (28.2)	
None	18 (17.8)	19 (12.2)	
Indication for surgery (*N*, %)			
Stricture	73 (72)	104 (66.7)	0.601*
Abscess	3 (3)	7 (5)	
Refractory to medical therapy	25 (25)	45 (28)	
Emergency surgery (*N*, %)	3 (3)	6 (4)	1.000‡

SP, single port; MP, multi-port; IQR, interquartile range; BMI, body mass index; AZA, azathioprine; 6MP, 6-mercaptopurine; MTX, methotrexate; TNF, tumour necrosis factor.
*Pearson's chi-squared test.
†Mann–Whitney *U*-test.
‡Fisher's exact test (two-tailed).

Table 2 Surgical specifics.

Surgical specifics	SP	MP	*P* value
N	101	156	
Duration of surgery (min) (median, IQR)	120.5 (90.2–173.7)	128 (100–170)	0.239*
Conversion to laparotomy (*N*, %)	3 (3)	9 (5.8)	0.299†
Surgical incision/extraction site (*N*, %)			
Umbilical	98 (97)	122 (78)	0.001‡
Suprapubic	3 (3)	30 (19)	
Other	–	4 (2.6)	
Length of incision (cm)	3.45	3.10	0.002
Anastomotic type (*N*, %)			
Stapled	88 (87)	144 (92)	0.032‡
Hand-sewn	13 (13)	8 (5)	
No anastomosis	–	4 (3)	
Type of anastomosis (*N*, %)			
S-S	93 (92.1)	122 (78.2)	0.002‡
S-E	–	2 (1.3)	
E-S	–	19 (12.2)	
E-E	8 (7.9)	9 (5.8)	
Additional procedure (*N*)	18 (18%)	41 (26%)	0.115‡
Strictureplasty	4	5	0.70
Sigmoid fistula repair	4	19	0.02
Sigmoid resection	2	6	0.48
Rectal wedge resection	–	1	1.00
Sigmoid resection bladder repair	–	2	0.52
Transverse colon wedge resection	–	2	0.52
Small bowel resection	3	3	0.68
Meckel diverticulum resection	4	2	0.20
Other (cholecystectomy/urachal cyst)	1	1	1.00
Stoma creation (*N*, %)	4	5	0.09†

SP, single port; MP, multi-port; IQR, interquartile range.
*Mann–Whitney *U*-test.
†Fisher's exact test (two-tailed).
‡Pearson's chi-squared test.

128 min (IQR 100–170) for SP and MP ICR, respectively ($P = 0.24$). The number of patients in whom the surgery was converted to an open approach was similar between the two groups (SP 3% *vs* MP 5.8%, $P = 0.38$). There were no conversions from SP to MP. The overall number of concomitant procedures performed was comparable between the two groups (SP 18% *vs* MP 26%, $P = 0.12$). However, a statistically significant lower rate of associated colonic procedures was registered for SP than MP (6 *vs* 30 colonic procedures, $P = 0.001$).

Postoperative pain and management

Patients in the SP group reported significantly lower postoperative pain VAS scores on postoperative days 1 and 2 than those in the MP group ($P = 0.016$ and $P = 0.04$, respectively) (Fig. 1). A reduction of analgesia administration (morphine, levobupivacaine/sufentanil), calculated as relative percentage of the dose administered on day 1, was registered on day 2 to maintain adequate pain control in the SP group compared with the MP group ($P = 0.007$) (Fig. 2). If patients undergoing additional procedures were excluded and the same comparison was made, there was a reduction in both postoperative VAS scores on days 1 and 2 ($P = 0.028$, $P = 0.031$) as well as analgesia administration on day 2 ($P = 0.018$). Morphine or levobupivacaine/sufentanil was discontinued on day 2 in a significantly higher number of patients in the SP group than the MP group (55% *vs* 39%, $P = 0.022$).

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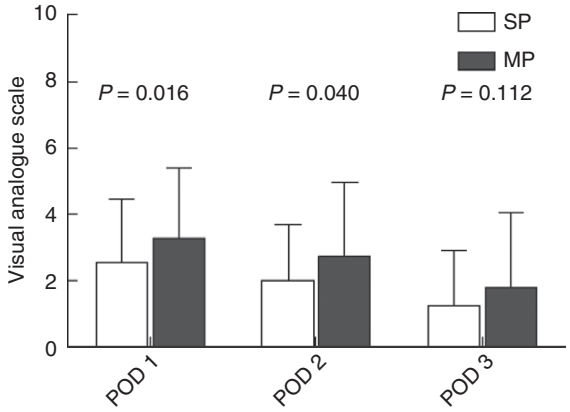

Figure 1 Postoperative visual analogue scale scores registered on POD 1, 2 and 3. Data are expressed as mean and SD (SP, single port; MP, multi-port; POD, postoperative day).

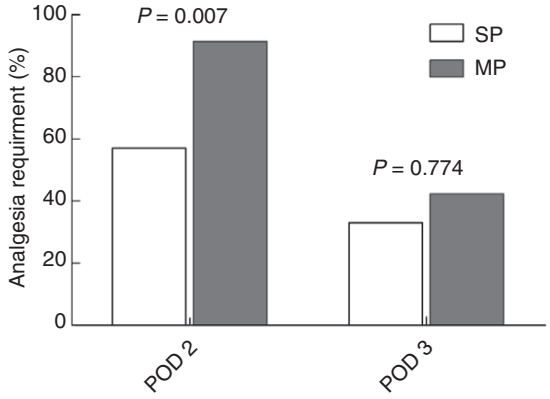

Figure 2 Proportion of postoperative analgesia requirement (including morphine and levobupivacaine/sufentanil), with regard to starting dose on POD 1, to maintain visual analogue scale scores < 4 on POD 2 and POD 3. Data are expressed as mean (SP, single port; MP, multi-port; POD, postoperative day).

Postoperative complications

No significant differences in the proportion of postoperative complications were observed between the two techniques (SP 24% *vs* MP 19%, $P = 0.38$) (Table 3). The proportion of re-interventions (6% *vs* 6%, $P = 0.95$) and hospital readmissions within 30 days of discharge (6% *vs* 3%, $P = 0.35$) were also comparable. In the SP group, six patients underwent urgent re-intervention, whereas nine patients in the MP group underwent a re-intervention. No differences in median hospital stay were observed between the SP and MP groups (6 *vs* 7 days; $P = 0.45$).

Discussion

This multicentre comparison between SP and MP ICR has shown that SP ICR is associated with less pain and faster postoperative opioid medication reduction but there were no differences in the other short-term outcome measurements.

Short-term postoperative outcomes are better when colorectal cancer surgery is carried out laparoscopically [15–17]. The same goes for ileocolic CD [2,18,19]. SP surgery, sometimes referred to as single incision laparoscopic surgery, is carried out through a single incision which becomes the extraction site [5]. The technique decreases abdominal wall trauma and so further reduces morbidity [20]. SP leads to better cosmesis, especially valuable in CD where patients are young and body image is particularly important. From a technical point of view, SP is sufficiently versatile to allow additional trocars to improve triangulation when the case is more

Table 3 Postoperative outcomes following SP and MP ICR.

Postoperative outcomes	SP	MP	*P* value
N	101	156	
Complications (*N*, %)	24 (23.8)	30 (19.2)	0.383*
Bleeding	5	5	
Anastomotic leakage	2	5	
Abdominal abscess	3	5	
Fluid collection	–	1	
Ileus	5	5	
Wound infection	–	2	
Other	8	7	
Complication grade†(*N*, %)			
I	4	8	0.494*
II	15	11	
IIIa	2	2	
IIIb	6	9	
Blood transfusion (*N*, %)	8	7	0.251*
Re-intervention (*N*, %)	6	9	0.954*
Time to first flatus (days)	2 (2–3)	3 (2–4)	0.108‡
Time to first bowel movement (days)	3 (3–4)	3 (2–4)	0.079‡
Postop fluid administered (POD)	2 (1–3)	1 (1–1)	0.001‡
Postop food intake (POD)	3 (2–4)	3 (2–4)	0.748‡
Hospital readmission (within 30 days) (*N*, %)	6 (5.9)	5 (3.2)	0.350§
Hospital stay (days)	6 (5.5–8.0)	7 (5–8.0)	0.403‡
Mortality (*N*, %)	–	–	

SP, single port; MP, multi-port; ICR, ileocaecal resection; POD, postoperative day.
*Pearson's chi-squared test.
†Clavien–Dindo classification of complications.
‡Mann–Whitney *U*-test.
§Fisher's exact test (two-tailed).

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complex than first thought. The SP incision can also be extended to allow the exteriorization of any inflammatory mass [8].

The safety and feasibility of SP for ileocaecal CD is established and there have been limited cohort studies comparing postoperative outcomes after SP and MP with equivalent morbidity rates reported [8,10–13]. The present study confirms this finding with no significant differences in postoperative complications, conversion to open surgery or stoma rate.

It is still a subject of debate as to whether CD patients treated with immunosuppressive therapy are more prone to develop postoperative septic complications [21,22]. In the current study, this was not a relevant consideration because both groups of patients were receiving similar background medications.

This study included patients with complex ileocaecal CD and accounts for the high rate of procedures additional to ileocaecectomy. This occurred more often with MP and, often, involved procedures involving sigmoid fistulas. According to these data, we cannot truly establish equal safety and feasibility of SP ICR *vs* MP for complex disease.

Patients were treated in tertiary referral centres specializing in IBD surgery where laparoscopic surgery was well established with skills transferrable to the more challenging SP technique. Our results might be more difficult to reproduce in less specialized units.

SP involves less abdominal trauma and for that reason alone might lead to less postoperative pain. Indeed, in one multicentre case-controlled retrospective comparison which included SP and MP colectomy for cancer, there was a significantly lower pain score on day 1 after the SP procedure [9]. Gardenbroek *et al.* have shown a reduction in morphine use at day 1 after SP ICR compared with MP ICR and there was no difference in VAS scores between the two groups [8]. We also report a significant reduction in analgesia (morphine, levobupivacaine/sufentanil) on day 2 in patients undergoing SP ICR. Lower pain scores were found on day 1 and 2 after SP laparoscopy and this further highlights that pain is more easily managed in the SP group.

We note that a significantly higher proportion of the MP patients had a suprapubic incision to harvest the specimen. The length of this incision did not differ from the umbilical incision in the same group. The incision length in the SP group was slightly longer. These findings support the hypothesis that additional lateral trocars might be responsible for differences in postoperative pain scores. The increased number of additional procedures performed during MP ICR might have generated imbalance between the two groups. However, a subgroup analysis (excluding patients undergoing additional procedures) confirmed a significantly lower postoperative VAS score as well as a faster analgesia reduction after the SP approach.

The present study compares the largest group of CD patients to date undergoing ICR by SP or MP laparoscopy. The strength of the study is that it is multicentre with clinicians experienced in managing IBD and its complications. A limitation is that the study is retrospective leading to a potential selection bias with patients selected from two different time periods. Additionally, differences in analgesia protocols and opioid drugs and the gradual introduction of enhanced recovery protocols might have affected results.

In conclusion, this large study confirms the safety and feasibility of SP ICR and shows short-term postoperative surgical outcomes comparable to MP ICR. Although more challenging, the SP approach could reduce postoperative pain and the need for prolonged postoperative opioids.

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MC, EG, MS and AB collected the data. MC, EG and AS drafted the manuscript. AB, MS, AW, CB, AD, WB and AS revised the manuscript for important intellectual content.

Conflicts of interest

None.

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