Preliminary results after single-port laparoscopic colonic surgery

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ABSTRACT

INTRODUCTION: Single incision laparoscopic surgery (SILS) may be even less invasive to patients than conventional laparoscopic surgery (CLS). The present study investigates the applicability of the procedure and we report the first year of experiences and operative quality.

MATERIAL AND METHODS: Patients were selected clinically and after computed tomography. Easy resections (or stoma creations) with small tumours, a body mass index < 30 kg/m^2 and American Society of Anesthesiologists group I-II were included. The data were prospectively registered until 1 January 2012. In the standard accelerated "fast track" programme, the use of additional opioids was registered.

RESULTS: SILS was performed in 24 patients including 15 patients with cancer resections. In eight stoma creations, no scars were left other than the stoma hole. The overall conversion rate was 17% and the complication rate was 13% with no wound infections. In the 15 SILS colon resections, median operation time (171 min.), blood loss (0 ml), lymph node harvest (median n = 14), dissection quality (73% mesocolic), specimen length (23 cm), height of vascular pedicle (8 cm) and hospital stay (three days) were comparable to international reports. One serious complication of small bowel injury was seen, but this was the only complication (7%) in this group.

CONCLUSION: With the proviso that our study population was limited in size, SILS seems equal to CLS in colorectal cancer surgery – although with a high conversion rate in the learning period, and it is a suitable procedure for minimal invasion in creation of a stoma.

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TRIAL REGISTRATION: not relevant.

Single incision procedures are evolving as part of minimally invasive surgery. Abdominal surgery has developed rapidly with cholecystectomies as the front runner. Besides the cosmetic advantage of this procedure, a randomised study has shown less post-operative pain with single incision laparoscopic surgery (SILS) compared with conventional laparoscopic surgery (CLS) [1], although intermediate results from another randomised study disprove this [2]. For colorectal procedures, retrospective comparative studies show that the benefits from SILS may include faster post-operative recovery, less frequent usage of narcotics and shorter hospital stay compared with CLS [3, 4]. A recent randomised study confirms these results [5]. Furthermore, the SILS technique offers the possibility of performing ostomy without any other incision than the hole needed for the stoma.

MATERIAL AND METHODS

In this paper, we summarise the experiences from the first year – 1 December 2010 to 1 January 2012 – with SILS operations in colorectal procedures performed by two surgeons who have been carrying out routine CLS for more than five years. The first procedures included in our series were selected after clinical judgement and computed tomography evaluation of the patients. The criteria for inclusion were an expectancy of an "easy operation" according to small tumour, body mass index (BMI) < 30 kg/m^2 and American Society of Anesthesiologists (ASA) group I-II. After some experience, these criteria were extended with regard to tumour size > 3 cm, BMI > 30 kg/m^2 and ASA group > II. SILS was performed whenever it was possible for the same two surgeons to participate owing to the daily schedule; otherwise, CLS was performed. A three-cm incision was used to insert a Covidien port or Apgar gel port in the umbilicus or at the marked site for a relieving ostomy. The instruments used were no different from those employed in routine use with CLS, which included a Ligasure for sealing of vessels, although a 5-mm optic was used instead of the routinely used 10-mm optic. According to advice from experienced SILS surgeons, it was decided to liberally use extra ports whenever progress in surgery was protracted. The first choice was a Minilap (Stryker) which makes incisions of only 2.3 mm; the second choice was a 5-mm port (Covidien).

Dissection was performed medially to laterally with exposition of the central vessels to the tumour-bearing part of the colon. With tumours in the right colon (no extended right hemicolectomies were performed), the ileocolic vessels were divided close to the confluence with the mesenteric vein and right colic vessels (if present) including right branches from medial colic vessels divided close to the mesenteric vein (**Figure 1**A). With sigmoid tumours, the inferior mesenteric vessels were divided close to the branching of, but with preservation

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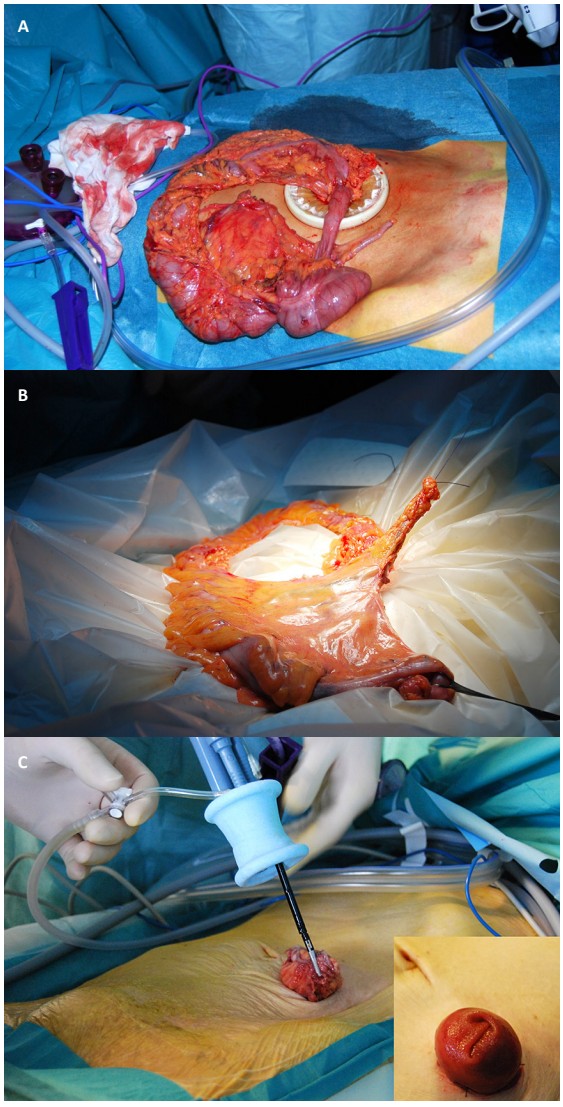
FIGURE 1



A. Right-sided hemicolectomy for cancer (seen in front) performed by single incision laparoscopic surgery in an Apgar gel port in the umbilicus.
B. Sigmoid resection for a cancer (seen in front) performed by single incision laparoscopic surgery with a Covidien port in the umbilicus. A plastic wound protector is insented to avoid port metastases.
C. Ostomy (sigmoid) performed in the single incision laparoscopic surgery port in a patient with multiple anal fistulas and incontinence from radiation treatment of anal cancer.

of the left colic artery (Figure 1B). This is also the standard procedures with CLS in our institution.

All patient variables, demographic and post-operative results were registered prospectively.

Pain scores and medications

According to the routine »fast track« programme in our department, all colorectal procedures have a post-operative scheme with no drains or tubes, early feeding, early mobilisation, laxatives, antipyretics (no antiphlogistics), gabapentin 300 mg twice for two days and only opioids on demand. Pain is measured on a visual analogue scale and when the patient scores more than 4, morphine is given intravenously as 5 mg or orally as 10 mg. For the sake of this report the staff and patients were blinded to the registration of post-operative opioid use. To avoid the bias of longer hospital stay on use of opioids, the registration was only made for the first two post-operative days.

Trial registration: not relevant.

RESULTS

A total of 24 patients were operated within the first year (13 months) with SILS colorectal procedures (**Table 1)**. Nine patients were operated for other reasons than cancer resection: One had an ileocoecal resection for a benign polyp and eight patients received an ostomy (three with advanced rectal cancer, two with multiple anal fistulas, one with incontinence, one with constipation who received an ileostoma and one with intermittent sigmoid volvolus who had a Hartmann's procedure). Dissection of adhesions was needed in two cases. One patient in the SILS palliative/benign-group had an initial 5-mm explorative port in the umbilicus before insertion of the SILS port in the stoma marking. It was therefore stated as a conversion although the port was not used (**Table 2**). Two patients had complications: one was readmitted with obstructive ileus seven days after the operation and one had excessive stoma output for one week (Table 2). The patient with ileus had the bowel uneventfully freed by laparoscopic release on the seventh post-operative day. No other complications were seen in this group.

The SILS cancer resection procedures were two high anterior rectal resections, seven sigmoid resections, two left hemicolectomies and four right hemicolectomies (Table 1). Supplemental adhesion dissection due to diverticulitis sequels was needed in two of these cases. In three cases of cancer resections, it was necessary to insert an extra port (minilap or 5 mm) and in one case (left hemicolectomy) the port was extended due to dissection difficulty and large tumour size (see Table 2). Other per- and post-operative results including oncological quality data (dissection plane, specimen length, vascular pedicle height and lymph node harvest) are shown in Table 2. One patient (right hemicolectomy) had a peroperatively unrecognized lesion to the terminal ileum and suffered from peritonitis. This patient was re-operated with an ileostomy on the third post-operative day and had a septic post-operative period of one week, but an otherwise uneventful course. No wound infections were seen in either group of SILS procedures,

DISCUSSION

In this study of the SILS procedure with colorectal procedures, we experienced no practical problems in performing ostomies. We had very few complications which were unrelated to the SILS procedure. The patients were left with no wounds other than the hole

TABLE 1

Preoperative data from 15 single incision laparoscopic surgery (SILS) colorectal cancer resections and nine SILS procedures of benign resections and palliative ostomies.

	SILS cancer resections (N = 15)	SILS benign/palliative (N = 9)
Female/male, n	5/10	4/5
Age, median (interquartile range), years	70 (65-77)	65 (41-71)
BMI, median (interquartile range), kg/m^2	24 (22-25)	24 (21-27)
ASA group, n		
I	6	1
II	8	6
III	1	1
IV	–	1
T stage, n		
1	1	–
2	2	–
3	9	–
4	3	3 rectal cancers
N stage, n		
0	9	–
1	5	–
2	1	–

ASA = American Society of Anesthesiologists; BMI = body mass index; N stage = nodule stage; SILS = single incision laparoscopic surgery; T stage = tumour stage.

TABLE 2

Per- and post-operative results of single incision laparoscopic surgery (SILS) colorectal cancer resections and SILS procedures of benign resections and palliative ostomies.

	SILS cancer resections (N = 15)	SILS benign/palliative (N = 9)
Conversion, n		
Extra port	3	1
Extension	1	–
Operation time, median (interquartile range), min.	171 (152-202)	99 (88-114)
Blood loss, median (interquartile range), ml	0 (0-50)	0 (0-0)
Tumour size, median (interquartile range), cm	3 (3-5)	–
Specimen length, median (interquartile range), cm	23 (19-27)	–
Dissection, n (%)		
Mesocolic	11 (73)	–
Intramesocolic	3 (20)	–
Intramuscular	1 (7)	–
Pedicle height, median (interquartile range), cm	8 (7-10)	–
Lymph node harvest, median (interquartile range), n	14 (12-27)	–
Intraoperative lesion, n	1 (small bowel)	0
Post-operative complication, n		
High stoma output	0	1
Ileus	0	1
Anastomotic leakage	0	0
Peritonitis	1	0
Death	0	0
Length of stay, median (interquartile range), days	3 (2-3)	4 (3-6)
Opioids on first 2 post-operative days, n/N (%)	7/15 (47)	4/9 (44)

SILS = single incision laparoscopic surgery.

needed for the stoma (see Figure 1C). Although it is possible to make the same operation assisted by a sigmoidoscope and a small incision in the ostomy marking, it is not possible to make the dissection of the sigmoid as visibly clear as with SILS. In three of the ostomy patients, there was almost complete occlusion of the rectum due to obstructing cancer and no endoscope could therefore be used in presenting sigmoid to the skin surface. Performance of a sigmoidostomy was the first SILS colon procedure completed in 114 min. in our department. The procedure for this indication is perfect in the SILS learning period as it increases confidence with the instruments and builds experience which solves the problems with instrument jamming. It may thereby raise the possibility of expanding the inclusion criteria as a BMI > 30 kg/m^2, like in our study. From a safety point of view, it is difficult to argue for a need of more than one port in patients who often need minimal invasion.

Colonic cancer resections with SILS may be technically difficult and were shown to last longer than CLS in previous reports [3, 6]. In our department, we have an overall median operation time of 180 min. for CLS right-sided hemicolectomies and 188 min. for CLS sigmoid resections. In previous reports, the SILS operating time for mixed colonic resections was shown to range from 75 [7] to 274 min. [3], which is comparable to the 171 min. seen in the present series including difficult operations such as left hemicolectomies and high anterior rectal resections. However, the SILS procedures were highly selected and no conclusions can therefore be drawn from our data. In a randomised study [5], no significant difference were seen in 2 × 25 patients (155 versus 124 min.), but one would expect that a difference of half an hour seen in [5] is likely to reach significance in a larger study population.

There were four conversions (three to CLS and one with an expansion of the incision to 12 cm) among cancer resections, which left a conversion rate of 27%. Including the palliative/benign SILS procedures in which no real conversions were performed, the overall conversion rate was 4/24 = 17%. This is somewhat higher than the overall conversion rate of 7% seen in a systematic review of 378 colonic SILS procedures [8]. In early reports of SILS colon cancer resections, a rate of 17% was seen [6, 9], and a high conversion rate may be due to the fact that this was an early experience for us. With surgeons having no experience from SILS cholecystectomies, we find that a liberal use of extra ports to enhance safety is better than presenting a low conversion rate.

The oncological quality of laparoscopic colectomy for colon cancer was previously seen with a lymph node harvest of ten to be comparable to open surgery [10]; however, the results of Hohenberger in open surgery has set the standard of mesocolic excision and a higher lymph node harvest [11]. The number of analysed lymph nodes, which is both dependent on the quality/size of the specimen and the eagerness of pathologic examination, is a prognostic factor in colorectal cancer [12]. A range of 13.5-27 harvested lymph nodes was seen in a recent review of malignant cases of SILS resections [8], which leaves the present series (median 14 lymph nodes) in the low end of the range. However, the tumours in the present study were small (median three cm) and the number of detectable lymph nodes may be dependent on the inflammatory response from the tumour, i.e. its size/extent and stage [13]. Whereas a median of 24 lymph nodes was harvested in a study of SILS resections including 49% stage III colon cancers [3], the present results may be more comparable to studies of SILS resections which included approximately 40% stage III cancers and harvested a median of 15 and 16 lymph nodes [5, 14].

In the present study the specimen lengths is also comparable to the 17-24-cm range seen in other SILS reports [7, 15-17]. Due to limited operating field/space with SILS, the laparoscopic forceps retraction during dissection may be replaced very frequently and also used to lift the specimen. This may result in specimen tears of the specimen, which also has to be extracted through a small incision in SILS procedures, and it may compromise the pathologic rating of the dissection plane. However, the cancer specimens were categorized as mesocolic dissection in 73% of the presented cases, which is comparable to a rate of 75% seen in a Danish hospital after implementation of a surgical educational training programme in complete mesocolic excision with central vascular ligation [18].

As also a median pedicle height of 8 cm in the present study is comparable to 82 mm seen after a surgical training programme [18], the oncological quality in the present study seems acceptable.

A matter of concern may be the occurrence of intraoperative lesions with laparoscopic surgery [19]. One SILS patient suffered from a small bowel lesion not recognized during surgery. Similar events with SILS have previously been reported by others [3]. We find this aspect important, especially because the only port in SILS may increase the number of blind angels; a situation which may theoretically be handled in CLS given the possibility of use of a scope in different ports. This critical point should receive attention in future reports on SILS colorectal procedures. However, a total post-operative complication rate of 3/24 (13%) in the present study is acceptable compared with 32% [3] and 13% [20] in the largest previous studies (73 mixed; and 100 right hemicolectomies) of SILS colon resections.

Use of opioids was seen in less than half of the patients in our study of the SILS technique. We have found five reports concerning post-operative pain after SILS colectomies [3-5, 7, 9]; three finding in favour of the procedure compared with CLS. Two of the five studies reported solely on pain scores [4, 7], another two reported solely on opioid use [3, 9]; and the only randomised study reporting on both pain score and opioid use showed a lower median post-operative wound pain score, but no difference in total post-operative morphine usage [5]. The previous studies [3, 5, 9] showed use of opioids post-operatively in more than half of the patients, but no conclusions of the present study can be drawn due to the different designs of opioid use (and analgetics) and the low number of patients.

The median hospital stay (LOS) was three days in the present study of SILS colon resections, which is also the median stay for patients operated with routine CLS in our department. In the studies including post-operative pain measurements in SILS versus CLS, LOS ranged from a median of three to seven days [3, 4]. A significant reduction in LOS was seen in three [3-5] of the five studies.

As these three studies also included more patients, it may be suggested that SILS may have benefits in earlier recovery compared with CLS in even larger study populations of colorectal resections. In our experience, the most important factors for early hospital release in an uncomplicated patient course may be pain, the use of opioids and the side effects from these opioids; i.e. post-operative nausea and ileus. Although the number of patients in our study may be too small to make conclusions on post-operative pain release and LOS, the experience from working one year with SILS has encouraged us to continue the development of the technique. A patient with almost invisible signs from a comprehensive and complication-weighed operation may inspire the surgeon; and the cosmetic appearance may – at least for some patients – seem attractive. Along with reports of survival and other factors such as post-operative adhesions and development of port hernias, we await eagerly the results from new larger randomised studies of SILS versus CLS in colorectal procedures.

In conclusion, we find the SILS method usable in colorectal surgery and safe for cancer resections of small tumours in a small selected study population presented within the first year of experience. The need of additional ports may be high in the learning period. The procedure may be useful in palliative stoma creation with no scars other than the stoma. According to the literature, it seems possible that SILS may have advantages in

post-operative recovery compared with CLS, but this has to be proven in a proper and larger blinded, randomised study.

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