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Single – Incision Laparoscopic Surgery for Rectal Cancer

Orhan Bulut
University of Copenhagen
Dept. of Gastrointestinal Surgery, Section of Colon and Rectal surgery
Hvidovre University Hospital, Copenhagen
Denmark

1. Introduction

There have been major advances in the treatment of rectal cancer in the last two decades. Improvements in surgical instrumentation has dramatically impacted the surgical approach to rectal cancer. Particularly laparoscopic procedures have been assumed a central role in the management of benign and malignant colorectal diseases as a result of a recent paradigm shift toward minimally invasive surgery. The reasons include faster recovery times with reduced hospital stay, fewer wound-related complications, better cosmesis and oncological outcomes identical to the open traditional procedures (1,2). Although conventional laparoscopic surgery (CLS) is less traumatic than open surgery, it still continues to be associated with tissue trauma due to the size and the number of ports, each at least 1-2 cm in length (3,4). Each incision carries potential morbidity risks of bleeding, visceral organ damage, pain and formation of incisional hernia. Morover the small incisions performed for trocar placement may results in multiple scar formation and compromised cosmetic outcome (5). Single-port access (SPA) or single-incision (SILS) laparoscopic surgery has been developed as a new alternative to conventional laparoscopy. SILS technique uses a solitary incision with a specialised multilumen (3-4) port and curved or articulated instruments. This surgical innovation obviates the need for triangulation, a fundemantal requirement of conventional laparoscopy, thus minimising the number of ports. SILS surgery is emerging as a method to help decrease morbidity, optimize the cosmetic benefits of CLS and minimize the surgical trauma. Early clinical series with various procedures have demonstrated not only the feasibility but also the safety of the SILS surgery (6,7). Recently, there is an increasing trend toward the application of SILS surgery in complex abdominal operations (8). Although there has been published accounts of SILS laparoscopic colon resections and some cases of proctocolectomy and total colectomy (9-16) the literature regarding SILS laparoscopic surgery for rectal cancer is currently very rare (17,18). This is probably due to the technical challenges of the rectal dissection and to the fact that the evidence for the use of CLS in the setting of rectal cancer is limited when compared with colon cancer.

This chapter will outline the current evidence for SILS as a treatment option for patients with rectal cancer and highlight the technical details of different procedures in rectal surgery.

2. Limitations and patient selection

Absolute contraindications to SILS for rectal surgery are the same as for laparoscopic colorectal procedures. Patients with serious underlying cardiovascular or pulmonary diseases, patients with peritonitis or gross fecal contamination of the peritoneal cavity, extensive adhesions in the operative field, patients with a high body mass index (BMI), and patients suspected of harbouring large intra-abdominal abscesses should not undergo SILS at the present.

Patient selection is crucial. There are several criterias for the selection of patient including the level and the size of rectal tumor, BMI, T-staging, previous intestinal surgery, evidence of tumor infiltration of adjacent organs, uncertinity of the clearance margins etc. Big midrectal tumors in male patients and bulky tumors are not suitable for SILS for rectum cancer at present. Intraoperative complications as uncontrollable bleeding, fecal contamination, inability to visualise critical anatomic landmarks or prolonged operative time without obvious progress in procedure should immediately result in conversion to multiport or conventional open surgery.

3. Recommended equipment

A single-incision port that provides access for several instruments is used. The range of available equipment and instrumentation applicable to SILS is currently undergoing a rapid innovative development. There are several commercial ports available on the market . In addition, there is also a possibility to use a self-constructed "home-made" multichannel port system using a surgical glove and a medium size of Alexis ™ wound retractor (Applied Medical, Santa Margarita, CA, USA) (Fig. 1a and 1b).

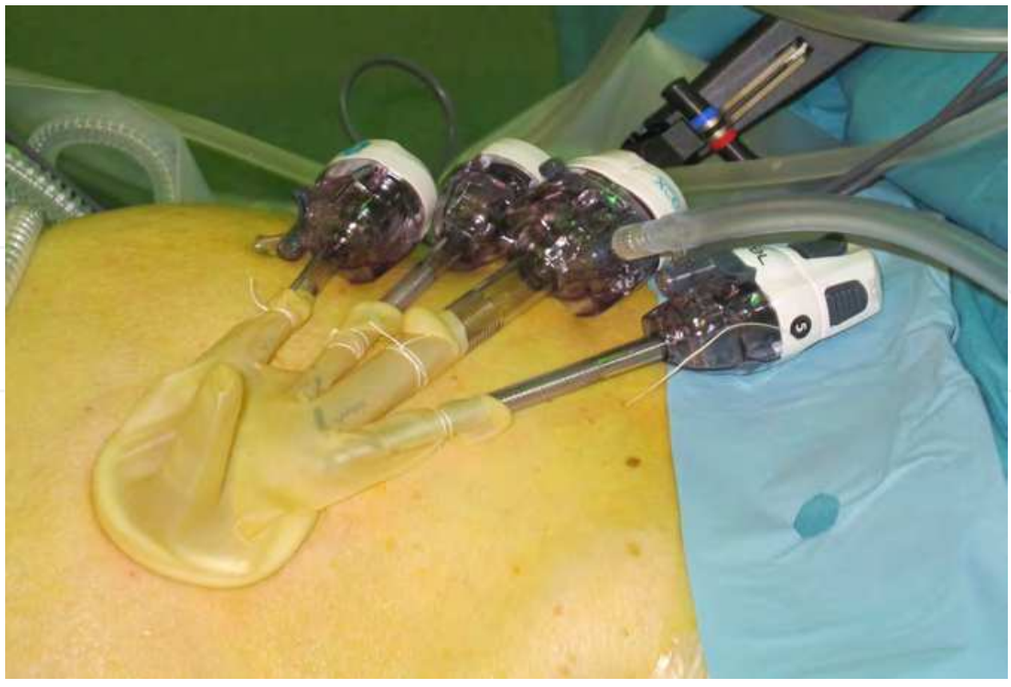


Fig. 1a. Self-constructed port with multiple trochars before establishment of the pneumoperitoneum



Fig. 1b. Operative photograph showing self-consructed port and external view of transabdominal suture.

A 30^0 high-definition laparoscopic camera with 5-mm diameter provides optimal visualization, for SILS for rectal surgery, especially when working in the deep pelvis. The basic hardware of laparoscopic instruments required include a tissue grasper for retraction of the intestine or applying the necessary traction on the mesentery and peritoneal attachments and an energi-based device for haemostasis and dissection (Fig. 2). Although some surgeons favour the use of atraumatic 5-mm flexible graspers, they are not essential for the performance of SILS for rectal surgery. We are now using standard straight graspers. Dissection can successfully be performed by energi-based devices as Harmonic scalpel or Ligasure in general. Endoscopic staplers are applied for ligation and division of the large vascular pedicles and for bowel transection and stapling. Multifired clip appliers are used for ligation of dissected vessels as well.

4. Patient preparation

Preoperative preparation of the patients for SILS of rectum is identical to that used in conventional multiport laparoscopic or open procedures. Preoperative preparation should include pathological examination, endoscopy, computed tomography (CT), liver ultrasound, chest x-ray and magnetic resonance imaging (MR) for diagnosis and staging in all patients with rectal cancer. Informed written consent must be obtained from all patients following discussion of risks and potential benefits with the operating surgeon. Patients should also be counselled that additional incisions and/or conversion to open surgery may be necessary as warranted during the operation. The routine anti-thrombotic precautions should be taken

with low-dosis heparin and TED stockings. Stoma sites are marked preoperatively. The patients may undergo a standard bowel preparation the day before operation or a phosphate enema is given as bowel preparation prior to surgery. All patients receive standard antibiotic prophylaxis at the induction of anethesia in our institution. An urinary catheter is placed to monitor urinary output and a nasogastric tube is placed to decompess the stomach temprorarily, if it is necessary.



Fig. 2. Basic instruments for SILS.

5. Operative setup and patient positioning

After anaesthesia induction, the patient is placed into Lloyd-Davis position. A right or left lower quadrant possible stoma site and/or umbilical site, depending on operative procedure and the location of rectal tumor, is used to access the abdomen. An open skin and fascial incision of 2,5 cm is used to access the abdominal cavity. The abdomen is entered under direct vision and the SILS port is placed. The abdomen is insufflated with CO2 to a pressure of 12 mmHg. We use a 5 mm straight long laparoscope with a 30^0 optic to image abdominal cavity. A 5 mm ultrasound dissector and a 5 mm endoscopic grasper, are introduced via two other 5 mm ports. The camera operator is located on the right side of the patient together with the surgeon in all patients operated with transumblical access and/or chosen stoma site in the right side of abdomen (Fig. 3). The surgeon stands with the camera assistant on the left side of the patient, when the chosen stoma and extraction site is located in the left lower quadrant.

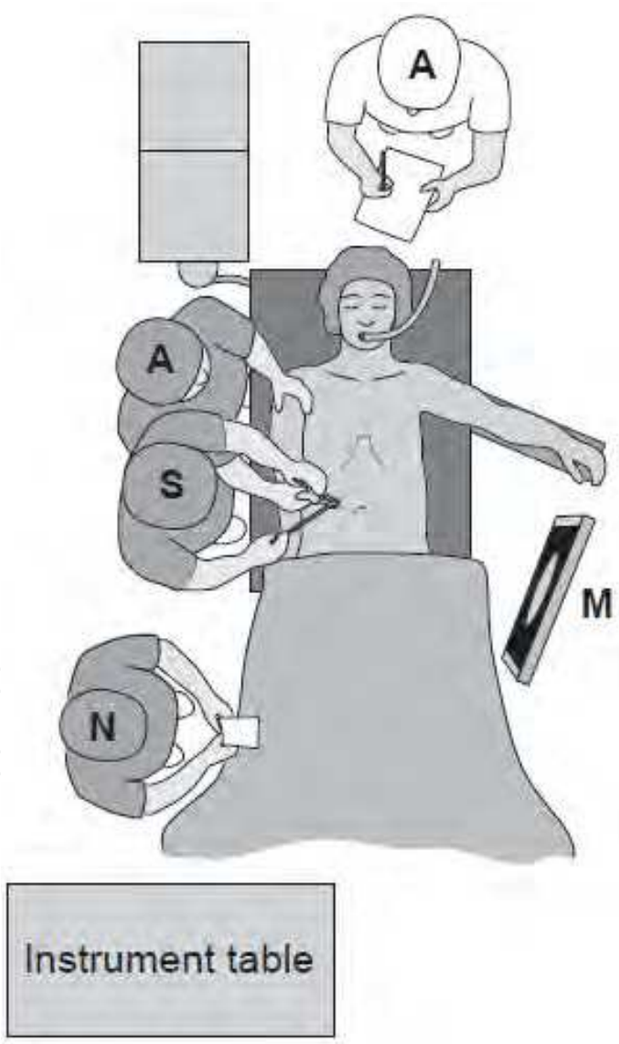
6. Operative techniques

The techniques developed during early clinical reports and case series including our personal experience are described below as stepwise procedure.

6.1 Low anterior resection

6.1.1 Position of the patient

After anaesthesia induction, the patient is placed into Lloyd-Davis position with padded leg stirrups (in Dan Allen). The shoulders and legs should be securely strapped to prevent any possible sliding of the patient on the operating table during the procedure, as the table will be tilted through several different directions during surgery to keep small intestine away from the dissecting field. There should be a free access to the patient´s perineum so that a stapler may be inserted for anastomosis and an endoscopic examination may be performed, if necessary. The arms are tucked to the patient´s side in general. However, for cases in which the anaesthesiologist needs access, left arm may be kept out for low anterior resection and right arm out for Hartmann´s operation and abdominoperineal resection (Fig. 3-4). This is because the assistant needs space to stand beside the surgeon during the whole procedure.



S: surgeon, A: camera assistant, N: nurse, A: anesthesiologist

Fig. 3. Schematic view of operating room setup for low anterior resection.

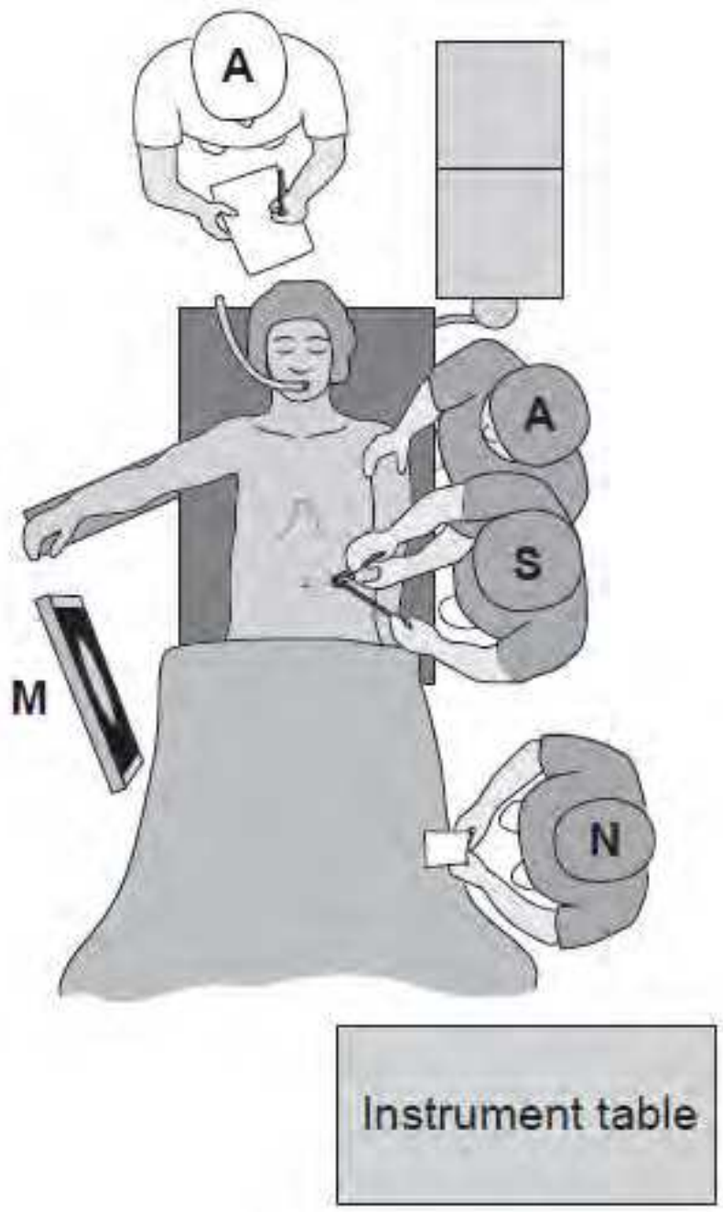


Fig. 4. Patient positioning and the surgical team for Hartmann´s operation and abdominoperineal resection.

6.1.2 Position of video monitor

The operative monitor should be located on the left side of the patient at approximately the level of the left knee for low anterior resection and the right knee for Hartmann´s operation and abdominoperineal resection. If there is a need for takedown of splenic flexure, the patient is placed in a reverse Trandelenburg position with left side elevated slightly as needed to assist with small bowel retraction and the monitor is now located near the left shoulder of the patient. The surgeon can also stand between the legs of the patient to get a better exposure of operative field as an option (Fig. 5).

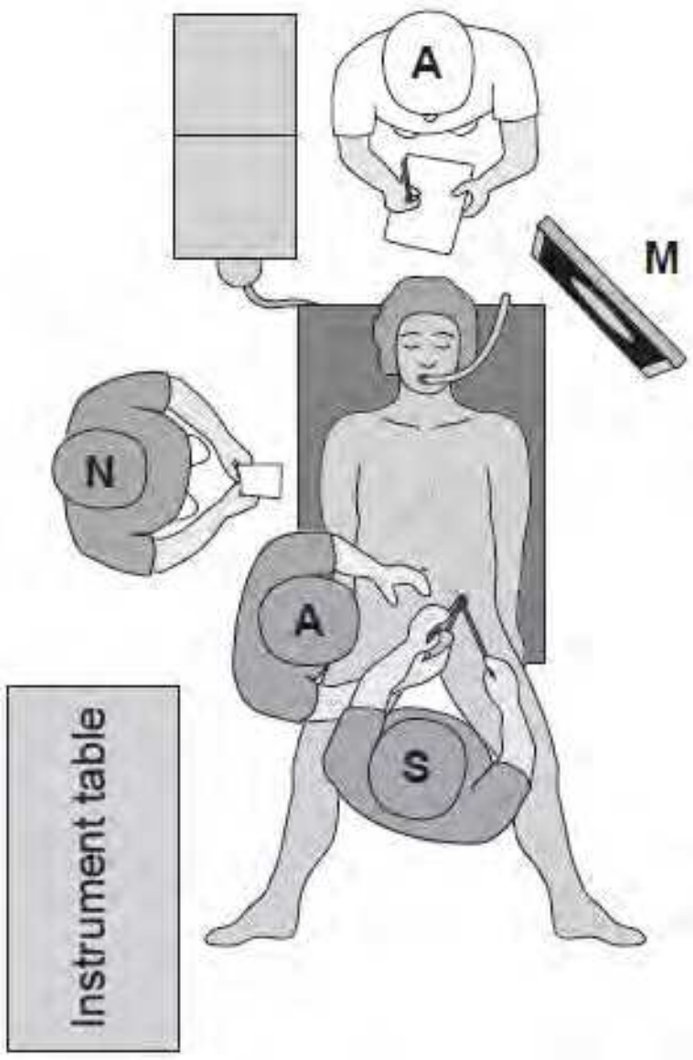


Fig. 5. Optional positioning of the surgical team for the takedown of splenic flexure.

6.1.3 SILS port placement

A right or left lower quadrant possible stoma site and/or umbilical site, depending on operative procedure and the location of rectal tumor, is used to access the abdomen. An open skin and fascial incision of 2,5 cm is done to access the abdominal cavity. The underlying fasciae is divided in a transverse fashion exposing the rectus abdominus muscle and the peritoneum is entered through the rectus muscle under direct vision and a SILS port is placed. The abdomen is insufflated with CO2 to a pressure of 12 mmHg. A 5 mm straight laparoscope with a 30° optic is used to image abdominal cavity. A 5 mm ultrasonic dissector and a 5 mm curved or straight endoscopic grasper, are introduced via two other 5 mm ports. The camera operator is located on the right side of the patient together with the surgeon in all patients, operated with transumblical access and/or chosen stoma site in the right side of abdomen. The surgeon stands on the left side of the patient, when the chosen stoma and extraction site is located in the left lower quadrant. The patient is then placed in steep

Trendelenburgs position and the operating table is rotated towards the right side for the pelvic portion of the procedure.

6.1.4 Technique

The surgeon and assistant are positioned on the right side of the patient (Fig. 6). The small bowel is gently swept out of the pelvis after performing initial laparoscopy. Subsequently the sigmoid colon is suspended towards the abdominal wall with transparietel sutures through the mesentery (Fig. 7). The peritoneum is incised along the groove between the right side of the inferior mesenteric pedicle at the level of the sacral promontory, opening the plane cranially up to the origin of the inferior mesenteric artery (Fig. 8). Blunt dissection is then used to lift the vessels away from the retroperitoneum and presacral autonomic nerves. Mesocolic dissection and inferior mesenteric pedicle isolation is achieved with medial approach and the inferior mesenteric artery is divided appoximately 1 cm. from the aorta after application of 5 mm clips (Endo Clip™ III 5 mm, Covidien, Norwalk, Connecticut, USA) or sometimes with Endo-GIA (vascular cartridge). The left ureter is then recognized and subsequently, with the patient placed supine and rotated left side up, medial-to-lateral dissection is continued cranially up until the left colon is mobilised. We do not routinely mobilize the splenic flexure in rectal surgery. If there is a need to take down the splenic flexure, the inferior mesenteric vein can be divided just inferior to the pancreas with medial dissection. The surgical team then repositions itself with the surgeon standing between the legs of the patients and the assistant on the right side of the patient (Fig. 5).



Fig. 6. Positioning of SILS port at proposed right-sided ileostomy site.

The divided pedicle is elevated, and the avascular retroperitoneal plane is dissected bluntly with medial approach entering into the lesser sac. If the splenic flexure is difficult to mobilize, the dissection can be commenced at the distal tranverse colon. The vascular plane between the greater omentum and the transverse colon is dissected close to the colon edge entering into the lesser sac. This dissection is continued going from the left side of the transverse colon toward the splenic flexure. The connection to the lateral dissection allows the left flexure to be fully mobilized.

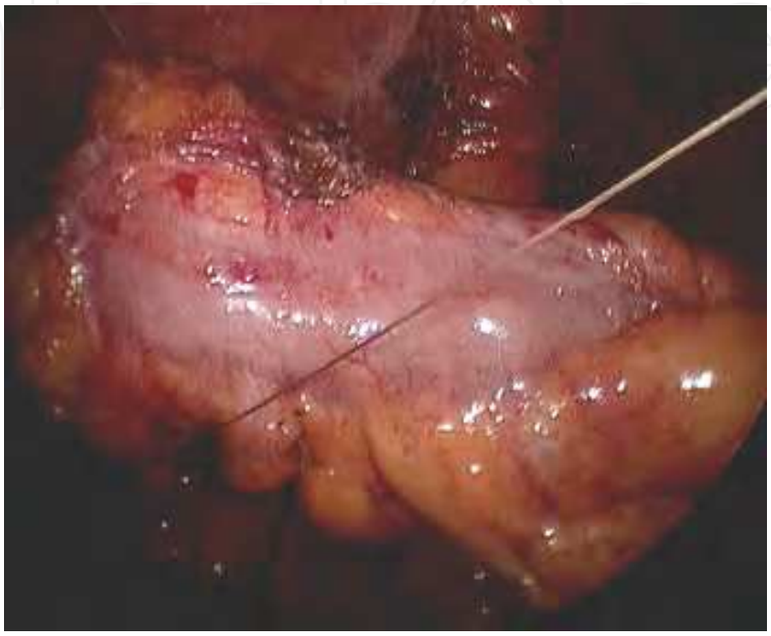


Fig. 7. The suspension of sigmoid colon with a transparietal suture.

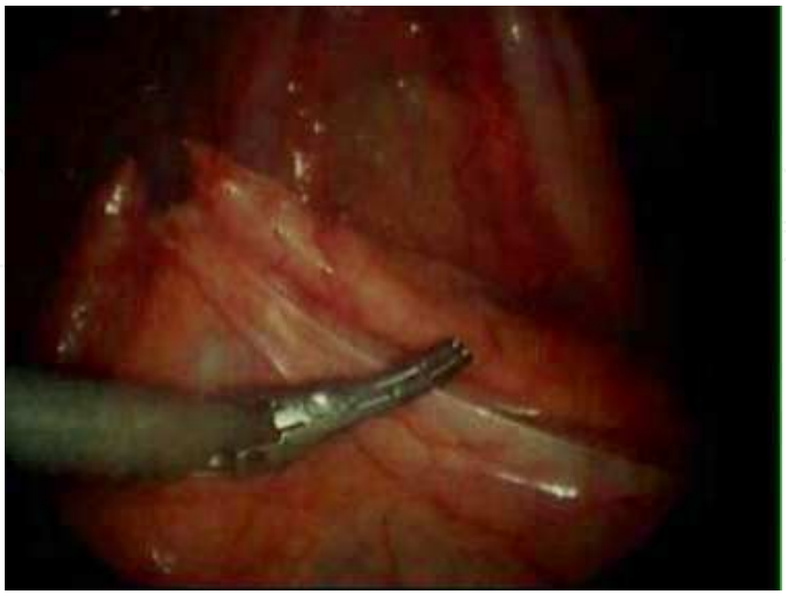


Fig. 8. Starting to open the medial peritoneum at the level of sacral promontory

The patient is returned to the Trendelenburgs position, and the small bowel is reflected cranially after the completion of full mobilisation of the left colon. The surgical team rearranges itself once again back to its original position. The grasper and previously inserted transabdominal sutures are used to elevate the rectosigmoid colon out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum is easily identified and the mesorectal plane dissected with ultrasonic scissors or electrocautery-based, intruments preserving the hypogastric nerves. Dissection is continued down to the presacral space in this avascular plane toward the pelvic floor. Elevation of the upper rectum by transabdominal sutures facilitates further posterior dissection along the back of mesorectum to the pelvic floor. The anterior dissection between the rectum and the posterior vaginal wall (in females) and the seminal vesicles and prostate (in men) is performed by decreasing tension of the transabdominal sutures and retracting the peritoneal fold anterior to the rectum. Dissection is proceeded laterally on both sides of rectum until circumferential mobilisation of lower rectum is accomplished. Digital examination is performed to verify the distance between tumors inferior margin and the line of resection and the adequacy of distal margin is marked with a clip. One 5 mm port is now replaced with a 10 mm port. A blue EndoGIA roticulator stapler (Covidien Ltd., Norwalk, Conn. USA) 45-mm is fired twice from this port to divide the lower rectum safely. The abdomen is then deflated and a wound protector (Alexis O ™, Applied Medical Rancho Santo Margarita, CA) placed at the aperture of SILS port. The specimen is extracted through the SILS aperture and resected. Extracorporal preparation of the proximale colon is completed with placement of the anvil of a 29–mm circular stapler in position to perform a side-to-end or end-to-end colorectal anastomosis.
After pneumoperitoneum reestablishment, a conventional intracorporeal colorectal anastomosis is made with transanal insertion of a circular stapler (Proximate ILS circular stapler, Ethicon, Endo-surgery, Puerto Rico USA) under direct vision. Testing for anastomosis is performed by insufflating air into the rectum while having the pelvic cavity filled with water. If there is a small leak it can be located by using methylene blue and eliminated by inserting a stitch that is tied intracorporally. This procedure often needs the insertion of an additional port. Drainage is not indicated routinely. As in open or CLS it is always imperative to check the resected tissue doughnuts to make sure they are complete. An incomplete doughnut should prompt a laparoscopic suture repair of the anastomosis. If the area of the defect is not recognised, the whole anastomosis should be revised and if necessary, interrupted sutures placed around the whole circumference. This is a challenging procedure with SILS technique at present. Therefore the procedure should be converted to either a CLS or an open operation. If the transumblical access is used, the fascia is closed with PDS sutures continuously and the skin is first trimmed to adapt the incision and is then closed with interrupted 3/0 nylon sutures (Fig. 9). In the cases needing a proximal diverting ileostomy, the diversion loop ilostomy is brought out through the SILS aperture approximately 20 cm proximate to the ileocoecal valve. The loop ileostomy is created using 3/0 vicryl sutures (Fig. 10). Intraabdominal smoke formation is drained via the insertion of a intravenous cannula working as a separate venting channel at the suprapubic site.

6.2 Hartmann´s operation

The procedure is similar to that of low anterior resection except that the splenic flexure need not be taken down routinely, there is no anastomosis and the mobilised colon is exteriorized

through the left premarked colostomy site which is used as the placement of a SILS port as well.



Fig. 9. Umblical wound after low anterior resection with transumblical access

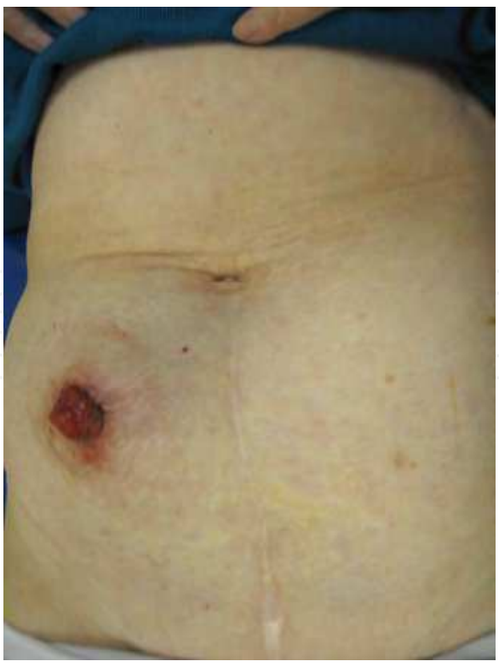


Fig. 10. Appereance at six days following low anterior resection with protective ileostomy performed with SILS technique.

An incision of 2,5 cm located at the marked stoma site on the left side is used to access the abdomen and the SILS port is placed. A 5 mm straight laparoscope with a 30 degree optic is used to image abdominal cavity. The surgeon and the camera assistant is located on the left side of the patient (Fig. 4). The patient is then placed in steep Trendelenburg position. Transabdominal sutures are used and rectosigmoid colon is suspended towards the abdominal wall. Mesocolic dissection and inferior mesenteric pedicle isolation is achieved with lateral approach by using 5 mm instruments**.** The superior rectal artery is divided just below the inferior mesenteric artery after application of 5 mm clips or Endo-GIA (vascular cartridge). The left ureter is then recognized and subsequently lateral-to-medial dissection is continued until the left colon is mobilised so that it may be brought up comfortably through the stoma site. Then the posterior aspect of the mesorectum is easily identified and the mesorectal plane dissected, preserving the pelvic nerves. The total mesorectal excision (TME) dissection is continued down to the presacral space in the avascular space towards the pelvic floor untill the level of os coccygis in the posterior level. At the anterior level the dissection is continued till the upper margin of the vagina. By decreasing tension of the transabdominal sutures to the sigmoid colon the anterior dissection can be performed. Lateral dissection is performed until circumferential mobilisation of the rectum is accomplished. A 5 mm port is replaced with a 10 mm port inside the device (SILS port). Digital examination is performed to verify the distance between tumors inferior margin and the line of resection and the adequacy of distal margin is marked with a clip. A blue EndoGIA roticulator stapler (Covidien Ltd., Norwalk, Conn. USA) 45-mm is fired to divide the lower rectum safely. The abdomen is then deflated and a wound protector (Alexis O ™, Applied Medical Rancho Santo Margarita, CA) placed at the aperture of SILS port. The specimen is extracted through the SILS aperture and resected. The divided left colon is brought out to form a colostomy in the SILS aperture and then the colostomy is fashioned with interrupted 3/0 vicryl sutures and a colostomy bag is attached to the skin**.**

There are some potential technical difficulties with operating from the left side of the patient:

1. Most of the laparoscopic colorectal surgeons, have not been familiar with left side approach and exposure to abdominal cavity through a left-sided port, although we have previously used traditional approach of the lateral-to-medial dissection sequence from the right side of abdomen. There is an adaptation process for laparoscopic surgeons to this approach.
2. The distance between left-sided single-port and anatomical landmarks as inferior mesenteric artery or left ureter are relatively short and this condition can limit the free manoeuvre possibilities of laparoscopic instruments and the facility of proper mesenteric dissection.
3. In some rare conditions in which the tumor coexists with a colonic inflammatory process (e.g., diverticulitis), the initial divisions of the sigmoid lateral attachments may be difficult and dangereous because the lateral dissection plane is blurred. There is an increased risk of inadvertent injury of left ureter and gonadal vessels.
4. If there is a need of early division of the white line of Toldt before vessel ligation increases the sigmoid redundancy and sometimes hinders the upcoming procedures (e.g. dissection of inferior mesenteric artery) during the operation. On the other hand, tilting of the patient to the right side allows gravity to aid in the retraction of the colon and makes identification of the ureter extremely simple.

6.3 Abdominoperineal resection

6.3.1 Abdominal approach

The abdominal part of the procedure is similar to that of low anterior resection except that the splenic flexure need not be taken down routinely and no distal rectal transection is required. The left lower quadrant premarked colostomy site is used as the placement of SILS port. The patient and surgical team positions are similar to those in Hartmann´s operation. An incision of 2,5 cm located at the marked stoma site on the left side is used to access the abdomen and the SILS port is placed. The surgeon and the camera operator is located on the left side of the patient (Fig. 11). The patient is then placed in steep Trendelenburg position.

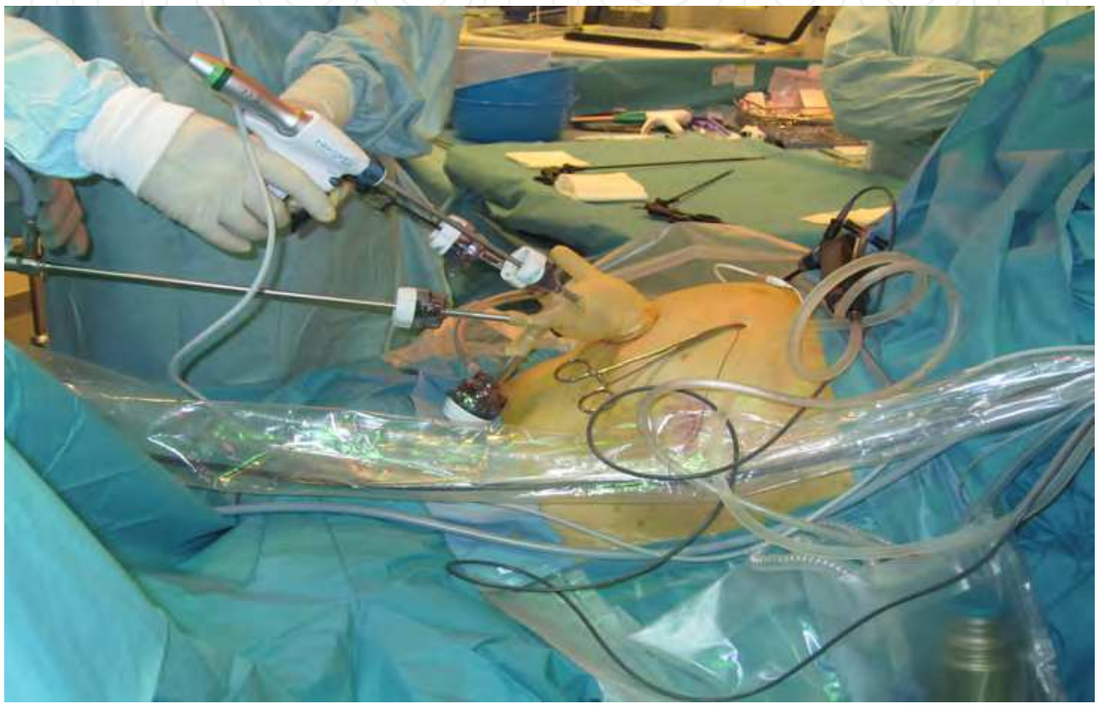


Fig. 11. Operative view of self-constructed port position at proposed left-sided colostomy site.

Mesocolic dissection and inferior mesenteric pedicle isolation is achieved with lateral approach by using 5 mm instruments and rectosigmoid colon is suspended towards the abdominal wall with transabdominal sutures**.** The superior rectal artery is divided just below the inferior mesenteric artery. The left ureter is then recognized and subsequently lateral-to-medial dissection is continued until the left colon is mobilised so that it may be brought up comfortably through the stoma site.Then, the posterior aspect of the mesorectum is easily identified and the mesorectal plane dissected with harmonic scalpel, preserving the pelvic nerves. The total mesorectal excision (TME) dissection is continued down to the presacral space in the avascular space towards the pelvic floor untill the level of os coccygis in the posterior level. At the anterior level the dissection is continued till the upper margin of the vagina. By decreasing tension of the transabdominal sutures to the sigmoid colon the anterior dissection can be performed. Lateral dissection is performed until circumferential mobilisation of the rectum is accomplished as mentioned the above. A 5 mm ports is replaced with a 10 mm port inside the device (SILS port). The sigmoid colon is

divided with a blue EndoGIA 60 stapler (Covidien Ltd., Norwalk, Conn. USA). The abdomen is deflated and the divided left colon is brought out to form a colostomy in the SILS aperture and then the left-sided colostomy is fashioned with interrupted 3/0 vicryl sutures**.**

6.3.2 Perineal dissection

The patient is then turned into jack-knife position with legs spread to enable the surgeon to stand between the legs with one assistant on each side (Fig. 12a). A purse–string suture is tied tightly to close the anus. After the skin is prepared, a drop formed incision around the anus is made and extended cranially to the coccyx (Fig. 1b). The dissection continues in the subcutaneous fat around the subcutaneous part of the external anal sphincter. The perineal incision is deepened into ischiorectal fossa on both sides and the outer side of the levator muscle is identified all around. A small transverse incision is made immediately proximal of the tip of os coccyx, which is disarticulated from the sacrum and Waldeyer´s fasciae divided (19). The pelvic or presacral cavity is entered and the incision into it enlarged by cutting the levator ani muscles on both sides, from posterior to anterior. The specimen is gently withdrawn and dissected off the prostate or posterior vaginal wall.



Fig. 12a. Patient in the prone jack-knife position (lateral view)

The anterior dissection is carried out immediately behind and to the upper level of the transversus perineal muscles and the dissection is completed with the division of the puborectalis muscle on both sides. In cases of anterior tumours with local invasion, a portion of the prostate or the posterior vaginal wall may be resected en bloc with the anorectum. In some cases, venous bleeding from the posterior and posterolateral aspect of the prostate or vagina can be troublesome. Meticulous haemostasis by diathermy or stitching can control this bleeding. When the specimen is removed and hemostasis is secured, the perineal wound is closed in layers using interrupted sutures with vicryl 2/0 and vicryl rapid 3/0 in the skin.



Fig. 12b. Patient in the prone jack-knife position (perineal view)

7. Complications

We have seen no specific complications following SILS for rectal cancer compared to conventional multiport laparoscopic surgery or conventional open surgery. There is no report about visceral or vascular injuries in the literature at present. We believe that there is a theoretical risk for unrecognized injury to viscera caused by the use of laparoscopic instruments away from the surgical field as in laparoscopic surgery. Wound complications will probably be shown to be decreased. However, complications with stoma and the perineal wound should remain unchanged.

8. Discussion

The SILS technique for rectal surgery is still in its infancy and the published studies are highly inhomogeneous. To date, a total of ten articles as single case reports and small case series have been available in the English literature on single-access laparoscopic rectal surgery. Table 1. summarizes the technical aspects and operative outcomes of SILS for rectal surgery. Operative outcomes are comparable with CLS in these very limited preliminary data. The data reviewed in this chapter shows the safety and feasibility of the procedure.

Authors	No. of Pts. (TCR/RS) (n)	Procedure (n)	Age (years) (range)	BMI (kg/m2) (range)	PAS (%)	Port type	Indication for RS (n)	OT(min) (range)	Incision length (cm) initial/final/range	C	Complications (n)	HLN (range)	LOS (days) (range)
Chambers et al. (25)	7/1	AR (1)	44	24	none	Triport	Benign	75	2.5/2.5/	0	0	NS	1
Bulut&Nielsen (17,18)	2/2	LAR (2)	(64-83)[c]	(20-24)[c]	50	SILS	Malignant (2)	(244-315)[c]	2.5/NS/2.5-3	0	0	(3-13)[c]	7
Gash et al. (26)	20/6	AR (2) LAR (3) APR (1)	(44-72)[c]	(24-26)[c]	*40	TriPort	Malignant (4#) Benign(2#)	(75-210)[c]	2.5/NS/NS	#1 to CLS	(5)* NS for rectal procedures	(14-19)[c]	(1-6)[c]
Law et al. (13)	8/1	AR (1)	76#(*49-88)	*22.7[b](17.7-27)	NS	TriPort	Malignant (1#)	*175[b](103-260)	3#/NS/*3-5	0#	None#	*13.5[b] (9-36)	3#
Hamzaoglu et al. (27)	4/4	AR (2) LAR (2)	(51-68)[c]	(22-35)[c]	NS	SILS and TriPort	Malignant (4)	347[a](240-480)	3.5/NS/3-4	0	None	15[a] (8-28)	(4-5)[c]
Ramos-Valades et al. (28)	35/6	AR (6)	*54.3±10.9[a] (29-78)	*28.1±6.3[a] (17.7-49)	*42.9	SILS and GelPornt	NS	158.8±31.8[b,#] (119-192)	¤2-2.5/4.0±1.2[b] /2.5-6	*2 to HALS *1 to CLS	(4)* NS for rectal procedures	¤23.5±12[b]	*2.9±1[b] (2-6)
Uematsu et al. (29)	7/7	LAR (7)	73[b] (52-88)	NS (20-24)	NS	SCP	Malignant (7)	205[b] 8175-245)	3/NS/NS	0	AL (1)	18[b] (13-27)	7[b] (7-21)
Katsuno et al. (30)	31/2	AR (2)	*66.5±5[b]. (58-79)	*22.5±2.3[a] (19-25)	NS	SILS and SCP	Malignant (2#)	*156±45[a] (101-263)	*2.72±0.79[b]/ NS /3-5	0	WI(1)	*18±2.1[a] (NS)	*9.2±1.2[a] (NS)
Bulut et al. (31)	10/10	AR (2) LAR (6) HO (1) APR (1)	67[b] (49-83)	23.5[b] (20-24)	60	SILS	Malignant (10)	229[b] (185-318)	NS	0	PC (1), CS (1)	14[b](3-20)	7[b] (4-14)

TCR total colorectal procedures, RS rectal surgery, AR anterior resection, LAR low anterior resection, APR abdominoperineal resection, HO Hartmanns operation, BMI body mass index, CLS conventional laparoscopic surgery, HALS hand-assisted laparoscopic surgery, HLN harvested lymph nodes, LOS lenght of hospital stay, OT operative time, PAS previous abdominal surgery, C conversion, NS not specified, SCP self-constructed port, WI wound infection, PC pelvic collection, UTI urinary tract infection, CS compartment syndrome, AL anastomotic leakage

* all patients

\# only for rectal surgery

¤ all malign cases

[a] mean data

[b] median data

[c] range

Table 1. Studies showing outcomes of single-incision laparoscopic rectal surgery

Although operative times seems to be longer in some series, nevertheless the results are in general comparable with conventional multiport laparoscopic rectal procedures. Another issue is the adequacy of oncological results of SILS for rectal cancer.

The adequacy of lymph node retrieval plays an important role in tumor staging and prognosis. A minimum number of 12 lymph nodes have been endorsed as a consensus standard of performance in colorectal resections (20). However, many factors affect the number of lymph nodes examined, including extent of surgical resection, patient age, tumor location, pathologist, surgeon and the method of specimen preparation. The data shows that the number of harvested lymph nodes in malignant cases appears oncologically satisfactory. The reported number of median or mean lymph nodes extraction in these cases are comparable to multiport laparoscopic series and population based studies (21-24). However, the given data regarding pathological examination and the shortness of follow-up are inadequate to evaluate the oncological outcome. A more detailed pathological report including margin clearance and the quality of mesorectal fasciae would be important to make long-term comparisons.

The potential advantages of a small skin incision include, not only better cosmetic appereance, but decreasing rate of port-site related complications. The final length of the skin and fasciae incision depends on specimen size. This is particularly important in rectal surgery due to relatively fast mesorectum. Extraction difficulties may often be encountered for the patients with large rectal tumors or thickened mesorectum. In addition, when the colon is full of stool in the case of distal stenosis, it is also difficult to bring the rectosigmoid colon out. The length of skin and fascia incision is often enlarged to permit the intact extraction of the specimen. Another expected advantage of a small incision is the reduction of postoperative pain. None of the published reports assessed the postoperative pain or analgesic requirements (32-35). Technical difficulties of single-access as the lack of triangulation and exposure, the inaxis view and conflicts between instruments are the most important challenges. The handling of both a grasper and an energi-based device in parallel with the laparoscope through the single port decreases the possibility of the surgeons manoeuvre and result in inadequate exposure and difficult dissection in the surgical field (Fig. 13).

To ensure an adequate and timely traction and to have a better surgical view and dissection, transparietal sutures are applied through abdominal wall. A 30^0 laparoscope and articulating or curved graspers are also helpful to improve view and dissection. The possibility of using a planned ileostomy or sigmoidostomy site as the port placement and extraction of the specimen reduced parietal trauma and improved cosmesis as a real no-scar procedure in some cases. The case studies in literature have shown that the length of stay did not appear to be decreased using SILS in rectal cancer. Health care systems have the duty to offer the citizen the best available medical care, taking economic cost and priority into consideration. SILS colorectal procedures stands now where conventional laparoscopic surgery stood in the early 1990s. Today, SILS for rectal cancer is under trial. Larger comparative studies to conventional laparoscopic surgery with oncologic outcomes, cost analysis and long-term results are necessary to determine patient benefits. Another important issue is the education of surgeons in the future. SILS for rectal procedures presents a challenge for teaching residents and surgeons. There are some similarities between SILS and Transanal Endoscopic Microsurgery (TEM). The colorectal surgical

community should use the experiences in training of surgeons in TEM for teaching SILS in the procedure.



Fig. 13. External view of the instruments working in parallel position through a self-constructed single port.

9. Conclusions

SILS for rectal cancer is a challenging procedure that seems to be feasible. These technical challenges could explain why the operating time may be considerably lengthened. When using SPA for complex procedures such as rectal cancer surgery, advanced laparoscopic experience is mandatory. In addition to this a significant learning curve must be expected. It can be performed safely on slim patients with no bulky tumour using one incision, either through the patient´s umbilicus or through a chosen stoma site which may become the diversion ileostomy or end-sigmoidostomy aperture. SILS has a potential of reducing postoperative pain. The decrease in incision number may decrease the development of wound infection or hernias and the formation of intra-abdominal adhesions as well as

improve cosmetic results. However, the existing clinical evidence is limited, and potential benefits or disadvantages of SILS procedures require further evaluation. There is a need to standardize the technique and carefully evaluate its oncological outcomes. Prospective comparative studies between SILS and conventional laparoscopic colorectal surgery are needed to clearly determine its short- and long-term outcome

10. The future

SILS is a major step after CLS and represents the crossing link between robotic surgery and NOTES (Fig. 14). The huge developments in the fields of imaging, data processing, simulation and virtual reality in the future have the potential to help SILS mature as computer-assisted single-access surgery through a single transabdominal incision or a natural orifice. It is believed that the future of minimally invasive surgery will be a hybrid form of SILS, NOTES and robotic surgery.

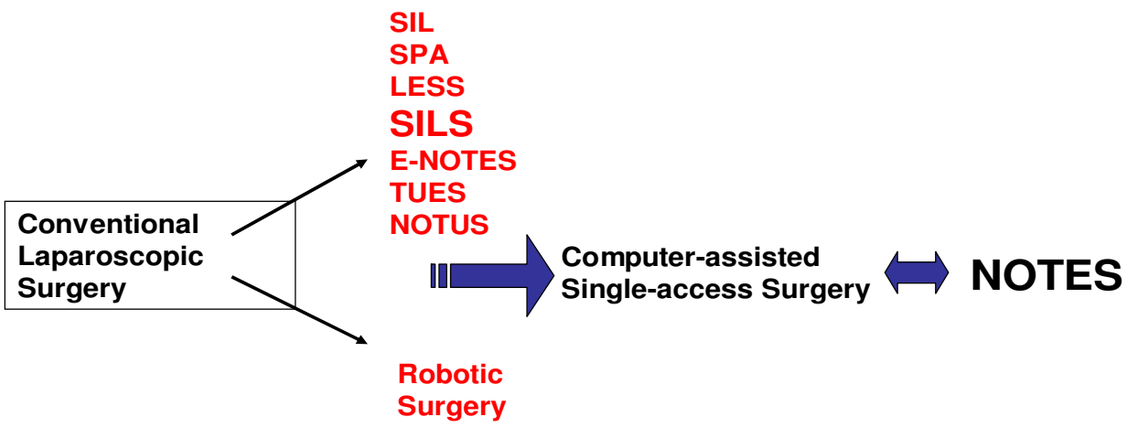


Fig. 14. The development of minimally invasive surgery in the future.

11. References

[1] Bonjer H.J., Hop W.C., Nelson H., et al.(2005). Laparoscopically assisted vs open colectomy for colon cancer: a metaanalysis. Arch Surg, 142, 298-303.

[2] Schwenk W., Haase O., Neudecker J., Muller J.M. (2008). Short term benefits for laparoscopic colorectal resection. Cochrane Database of Systematic Reviews. CD003145.

[3] Lowry P.S., Moon T.D., D'Alessandro A., Nakada S.Y. (2003). Symptomatic port-site hernia associated with a non-bladed trocar after laparoscopic live-donor nephrectomy. J Endouro, l17,493-49413.

[4] Marcovici I. (2003). Significant abdominal wall hematoma from an umbilical port insertion. JSLS, 5, 293-295.

[5] Dunker M.S., Stiggelbout A.M., van Hogezend R.A., Ringers J., Griffioen G., Bemelman W.A. (1998). Cosmesis and body image after laparoscopicaly-assisted and open ileocolic resection for Crohn's disease. Surg.Endosc,12,1334-1340.

[6] Raman J.D., Bagrodia A., Cadeddu J.A. (2009). Single-incision, umbilical laparoscopic versus conventional laparoscopic nephrectomy: a comparison of perioperative outcomes and short-term measures of convalescence. Eur Urol, 55, 1198-1204.

[7] Podolsky E.R., Curcillo P.G. 2nd. (2010). Single Port Access (SPA) Surgery-a 24-Month Experience. J Gastrointest Surg, 14, 759-767.

[8] Ahmed K., Wang T.T., Patel V.M., et al. (2011). The role of single-incision laparoscopic surgery in abdominal and pelvic surgery: a systematic review, 25, 378-396.

[9] Remzi F.H., Kirat H.T., Kaouk J.H., Geisler D.P. (2008). Single port laparoscopy in colorectal surgery. Colorectal Dis, 10, 823-826.

[10] Remzi F.H., Kirat H.T., Geisler D.P. (2010). Laparoscopic single-port colectomy for sigmoid cancer. Tech Coloproctol, 14, 253-255.

[11] Bucher P., Pugin F., Morel P. (2008). Single port access laparoscopic right hemicolectomy. Int J Colorectal Dis, 23, 1013– 1016.

[12] Bucher P., Pugin F., Morel P. (2009). Single-port access laparoscopic radical left colectomy in humans. Dis Colon Rectum, 52,1797- 1801.

[13] Law W, Fan J.K.M., Poon J.T.C. (2010). Single-incision laparoscopic colectomy: early experience. Dis Colon Rectum, 53, 284-288.

[14] Wong M.T.C., Ng K.H. , Ho K.S., Eu K.W. (2010). Single-incision laparoscopic surgery for right hemicolectomy: our initial experience with 10 cases. Tech Coloproctol, 14, 225-228.

[15] Geisler D.P., Condon E.T., Remzi F.H. (2010). Single incision laparoscopic total proctocolectomy with ileopouch anal anastomosis. Colorectal Dis, 12, 941-943.

[16] Ramos-Valadez D.I., Chirag B. Patel, M.R., Pickron T.B., Haas E.M. (Published online ahead of print 2010).Single-incision laparoscopic right hemicolectomy: safety and feasibility in a series of consecutive cases. Surg. Endosc, DOI: 10.1007/s00464-010-1017-y.

[17] Bulut O. and Nielsen C.B.(2010). Single-incision laparoscopic low anterior resection for rectal cancer. Int J Colorectal Dis, 25,1261-1263.

[18] Bulut O. and Nielsen C.B. (2011). Single-incision laparoscopic low anterior resection combined with salpingooferectomy. Ugeskrif for Læger (in press)

[19] Holm T., Ljung A., Haggmark T., Jurell G. and Lagergren J.(2007). Extended abdominoperineal resection with gluteus maximus flap rekonstroction of the pelvic floor for rectal cancer. Br. J Surg, 94, 232-238.

[20] Nelson H., Petrelli N., Carlin A., et al. (2001). Guidelines 2000 for colon and rectal cancer surgery. J Natl Cancer Inst, 93, 583-596.

[21] Guillou P.J., Quirke P., Thorpe H., et al.(2005). MCR CLASICC trial group. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MCR CLASICC trial):multicentre, randomised controlled trial. Lancet, 364, 1718-1726.

[22] Park J.S., Kang S.B., Kim D.W., Lee K.H., Kim Y.H.(2009). Laparoscopic versus open resection without splenic flexure mobilization for the treatment of rectum and sigmoid cancer: a study from a single institution that selectively used splenic flexure mobilization. Surg Laparosc Endosc Percutan Tech, 19, 62–68.

[23] Kang S.B., Park J.W., Jeong S.Y., et al.(1010). Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial): short-term outcomes of an open-label randomised controlled trial. Lancet Oncol, 11, 37-645.

[24] Baxter N.N., Virnig D.J., Rothenberger D.A., Morris A.M., Jessurun J, Virnig BA. (2005). Lymph node evaluation in colorectal cancer patients: a population-based study. J Natl Cancer Inst, 97, 219-225.

[25] Chambers W., Bicsak M., Lamparelli M., Dixon A. (2011). Single-incision laparoscopic surgery (SILS) in complex colorectal surgery: a technique offering potential and not just cosmesis. Colorectal Dis, 13, 393-398.

[26] Gash K.J., Goede A.C., Chambers W., Greenslade G.L., Dixon A.R. (Published on line 24 august 2010). Laparoendoscopic single site surgery is feasible in complex colorectal resections and could enable day case colectomy. Surg Endosc, DOI 10.1007/s00464-010-1275-8.

[27] Hamzaoglu I., Karahasanoglu T.; Baca B., et al. (2011). Single-port laparoscopic sphincter-saving mesorectal excision for rectal cancer. Report of the first 4 human cases. Arch Surg, 146,75-81.

[28] Ramos-Valadez D.I., Chirag B. Patel, M.R., Pickron T.B., Haas E.M. (Published on line: 29 march 2011). Single-incision laparoscopic colectomy: outcomes of an emerging minimally invasive technique. Int J Colorectal Dis, DOI10.1007/s00384-011-1185-9.

[29] Uematsu D., Akiyama G., Narita M., Magishi A. (2011). Single-access laparoscopic low anterior resection with vertical suspension of the rectum. Dis Colon Rectum, 54, 632-637.

[30] Katsuno G., Fukunaga M., Nagakari K., Yoshikawa S., Ouchi M., Hirasaki Y. (2011). Single-incision laparoscopic colectomy for colon cancer: Early experience with 31 cases. Dis Colon Rectum, 54,705-710.

[31] Bulut O., Nielsen C.B. and Jespersen N. (2011). Single-port access laparoscopic surgery for rectal cancer: Initial experience with 10 cases. Dis Colon Rectum, 54, 803-809.

[32] Adair J., Gromski M.A., Lim R.B., Nagle D. (2010). Single-incision laparoscopic right colectomy: Experience with 17 consecutive cases and comparison with multiport laparoscopic right hemicolectomy. Dis Colon Rectum, 53,1549-1554.

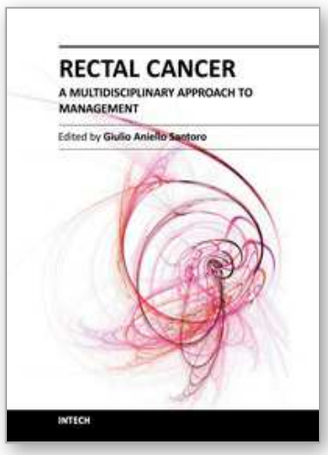
[33] Waters J.A., Guzman M.J., Fajardo A.D., et al. (2010). Single-port laparoscopic right hemicolectomy: A safe alternative to conventional laparoscopy. Dis Colon Rectum, 53, 1467-1472.

[34] Chen W.T.L., Chang S.C., Chiang H.C. et al. (Published on line 27 february 2011). Single-incision laparoscopic versus conventional laparoscopic right hemicolectomy: a comparison of short-term surgical results. Surg Endosc. DOI 10.1007/s00464-010-1481-4.

[35] Champagne B.J., Lee E.C., Leblanc .F, Stein S.L. and Delaney C.P. (2011). Single-incision vs straight laparoscopic segmental colectomy: A case-controlled study. Dis Colon Rectum, 54,183-186.

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Dramatic improvements in medicine over the last few years have resulted in more reliable and accessible diagnostics and treatment of rectal cancer. Given the complex physiopathology of this tumor, the approach should not be limited to a single specialty but should involve a number of specialties (surgery, gastroenterology, radiology, biology, oncology, radiotherapy, nuclear medicine, physiotherapy) in an integrated fashion. The subtitle of this book "A Multidisciplinary Approach to Management" encompasses this concept. We have endeavored, with the help of an international group of contributors, to provide an up-to-date and authoritative account of the management of rectal tumor.

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Slavka Krautzeka 83/A
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Phone: +86-21-62489820
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