Single port laparoscopic colectomy for colonic cancer

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Abstract:

Objectives: **The evaluation of feasibility, safety, and outcomes of single port laparoscopic colectomy (SPLC) for colonic cancer. Prospective study of 114 patients with colonic cancer (84 right side, 17 left side, and 13 sigmoid colon) who underwent SPLC between October 2010 and October 2016 in Hue Central Hospital.** ***Results:*** **Mean age of patients was 56.1±15.2 (25-87 years), male/female ratio was 70/44. Mean BMI was 23.5±2.2 kg/m^2. Procedures included 84 right hemi-colectomies (73.7%), 17 left hemi-colectomies (14.9%), and 13 sigmoidectomies (11.4%). Six cases required additional ports, and 19 were converted to open surgery. Mean tumor size was 3.7±2.7 cm. Stage I: 6.1%; stage IIa: 43.9%; stage IIIa: 36.8%; and stage IIIc: 13.2%. Mean operation time was 160.5±75.5 min. There had been no deaths/intraoperative complications. Mean incisional length (including extraction) was 5.5±2.2 cm. Mean lymph nodes was 16.2±4.5. Mean hospital stay was 7.5±6.1 days. The surgical site infection rate was 3.5%, and 1 patient required reoperation (anastomotic leakage: 0.9%). After 32.2±7.5 (3-65 months) follow-up, there were no late surgical complication, incisional hernia, or incision metastasis. There were five local recurrences, and three patients developed liver metastasis in the open conversion group. The overall survival time after 2 years was 87.5%, and after 5 years, it was 59.4% (Kaplan-Meier).** ***Conclusion:*** **SPLC is feasible and safe procedure for the treatment of colon cancer. The cosmetic value is better (short incision confounded by umbilicus). Other outcomes were equivalent to conventional laparoscopy.**

Keywords: ***colon cancer, single port laparoscopic colectomy.***

Classification number: ***3.2***

Introduction

Colonic cancer is among the most commonly occurring cancers (ranking 2nd in women and 3rd in men) in the world and the 4th cause of death after lung, stomach, and liver cancer [1]. In Vietnam, colorectal cancer is the 4th leading cause of death after gastric cancer, lung cancer, and liver cancer [2].

Since Jacobs successfully performed the first laparoscopic right hemi-colectomy for a cecal tumor in 1991, laparoscopy for colon cancer has been widely used, and it is as effective as open surgery in oncological terms [3].

In 2008, P. Bucher, et al. reported the first case right hemicolectomy by single port access laparoscopy and in 2009, single-port access laparoscopic radical left colectomy was successfully performed and reported [4].

SPLC allows intra-abdominal operation through a small umbilical incision [5]. With the development of techniques and instruments (Harmonic-Scapel, Ligasure, etc.), SPLC is being widely and successfully applied around the world [5, 6].

This study aimed to evaluate the feasibility, safety and early results of this technique.

Materials and methods

Materials: 114 colon cancer cases confirmed by preoperative colonoscopic biopsy. All tumors were ≤8 cm, stage III or under, non-invasive to adjacent organs, with no distant metastasis on CT-scan. Patients were ASA 1-3.

Methods: Prospective study: general characteristics of patients, surgical procedures, conversion rate, complications during and after surgery, the results of surgery, and hospital stays were collected for analysis.

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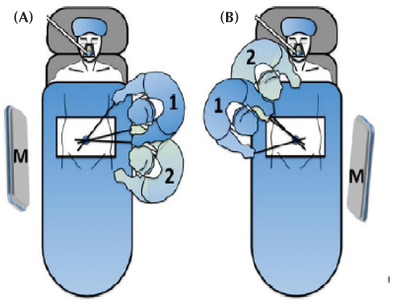


Fig. 1. Position of patient, surgeon, and assistant. (A) Right colon, **(B)** Left colon and sigmoid colon.

Equipment: Karl-Storz endoscopes 30^0 (5 mm diameter, 60 cm length), SP from COVIDIEN, long and conventional laparoscopic instruments, staplers, etc.

Technique: The patient was underwent general anesthesia, supine for right colon cancer and in lithothomy position for left colon and sigmoid colonic cancer (Fig. 1).

Insufflation; longitudinal incision through the umbilicus (2-2.5 cm); placement of SP device; insufflation of CO_2 into the peritoneal cavity (12 mmHg).

Ligation of blood vessels close to their origins; mobilization of the colon; removal of the SP device; and expanding the incision, if necessary.

Placement of the incision protective device; removal of the colon and tumor; and anastomosis performed by hand or stapler (Figs. 2-5).

Fig. 2. SP right hemi-colectomy.

Fig. 3. Specimen with ascending colonic cancer.

MACROSCOPIC HISTOLOGIC FEATURES

Colectomy specimen contain a bowel segmental length 20cm, diameter 4cm. Distance 6cm from tumor to distal margin resection. Many mesocolonic lympho nodes 0.2-1.0cm

(1) Proximal margin resection, (2) Distal margin resection

MICROSCOPIC HISTOLOGIC FEATURES

Colonic adenocarcinoma with large nucleus, eccentrically placed nuclei, abundant cytoplasm, a tubular microscopic pattern, invaded into the submucosa of the colon.

19 evaluated lympho nodes: Negative

Both margin resections: Negative

CONCLUSION

Well differentiated colonic adenocarcinoma

(pT2N0M0, Stage I)

Fig. 4. Post-op pathology with 19 lymph nodes examined.

Fig. 5. Scar after 2 years.

Results

General characteristics of patients

	n=114	%
Male/Female	70/44	1.6/1
Mean age Min Max	56.1±15.2 25 87	
BMI (kg/m^2)	23.5±2.2	
Adenocarcinoma (colonoscopy + biopsy)	114	100
Tumor size/CT scan (cm) Min Max	3.7±2.7 3 8	
CEA (ng/ml) < 5 ≥ 5	 52 62	 45.6 54.4

Surgical techniques

Procedures performed	N	%
Right hemi-colectomy	84	73.7
Left hemi-colectomy	17	14.9
Sigmoidectomy	13	11.4

Conversion

Open conversion	n=19	16.7%
Right colon	17	14.9
Left colon	2	1.8
Additional trocars	**n=6**	**5.3%**
Right colon	4	3.5
Left colon	2	1.8

Causes for open conversion

Causes	n=19	16.7%
Peritumoral inflammation	7	6.1
Tumoral invasion	12	10.5

Operative results

	Min	Max	Mean
Operating time (minutes)	140	300	160.5±75.5
Lymph nodes examined	12	25	16.2±4.5
Incisional length (cm)	4	10	5.5±2.2
Drain	n=5		4.4%
Postoperative pain (days)	2	6	4.1±2.5
Bowel movement return (days)	2	5	3.5±1.2
Hospital stay (days)	6	16	7.5±6.1
Incisional infection	n=4		3.5%
Anastomotic leakage	n=1		0.9%

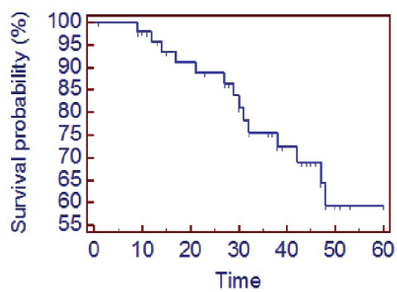
Staging

Stage	n	%
Stage I	7	6.1
Stage IIa	50	43.9
Stage IIIa	42	36.8
Stage IIIc	15	13.2
Stage IV	0	0

Postoperative follow-up

Mean time follow-up 32.2±7.5 (3-65) months	N	%
Postoperative CEA ≥ 5 ng/ml	25	21.9
Liver metastasis	3	2.6
Local recurrence	5	4.4
Lung metastasis	0	0
Incisional hernia	0	0
Incisional metastasis	0	0

Overall survival time (Kaplan-Meier)



After 2 years: 87.5% and after 5 years: 59.4%.

Discussions

Based on our experience, in 114 patients with colonic cancer undergoing SPLC, there were 19 conversions, six needed additional ports; there were no deaths, no intra-operative complications, and only one case of anastomotic leakage. Four patients had surgical site infections. This study showed that SPLC treatment of colon cancer is feasible and safe.

Although the patients had been selected before the surgery, the general characteristics of the patients in our study were similar to other studies. The mean age of the study: 56.1±15.2 years. This result was similar to those of other domestic or international studies [7, 8].

Regarding the sex, there were 70 males and 44 females in our study. This foctor was different from the results of several studies, including those of William Tzu-Liang Chen's study [9] and B. Peter's study [1]. However, this difference did not affect the outcomes of SPLC.

The overweight patients are more difficult since mesenteric blood vessel cannot be seen easily [10]. It is well recognized that this is one of the factors that leads to the conversion from SP laparoscopy to conventional laparoscopy or laparotomy [9]. This influence is especially evident in SP laparoscopy. Indeed, I. Diego, et al. found the conversion rate was higher in the group with BMI over 25 kg/m^2 compared to the group with BMI less than 25 kg/m^2 [11]. The average BMI in our study was 23.5±2.2 kg/m^2. The conversion rates in other studies of SP laparoscopy had relatively low BMI, such as the meta-analysis study of T. Makino, et al. had BMI of 25.5 kg/m^2 [3], the meta-analysis study of A.K. Fung, et al. had 25.8 kg/m^2 [7]. Even in the randomized comparative study of William Tzu-Liang Chen, et al., BMI was 23.3 kg/m^2 [9]. Thus, we could consider the BMI in our study was similar to other studies.

Our selection of patients with tumor size on CT scan averaged at 3.7±2.7 (2-8) cm. Randomized comparative study of H.T. Papaconstantinou, et al., in the SP laparoscopic group, the average tumor size was 4±2 (0.9-9.5 cm) [12]. Thus, the criteria for patient selection related to the size of our tumor was similar to other authors.

Another factor related to SPLC in colon cancer is surgical procedure. Most published studies have evaluated the feasibility and safety of right SPLC [1, 6, 9, 11, 13]. Only a few studies

studied left SPLC [14, 15]. Most authors agree that SP laparoscopy of left colectomy or sigmoidectomy, which requires dissection in the pelvis and freeing the splenic flexure, is more difficult. According to F. Leblanc, et al. both medial to lateral and lateral to medial approaches were used to ligate the vessels for 11 right and 6 left colectomies [16]. The small rate of left hemicolectomy or sigmoidectomy in our study was not due to that reason. In our study, there were only 17 left colon cancers. Most of the patients with left colon cancers hospitalized in our department were in intestinal sub-occlusion or occlusion situation; thus, we couldn't select them for our study.

Operating time for SP laparoscopy was longer than conventional laparoscopy in the randomized comparative study of William Tzu-Liang Chen, et al. [9] with an average operating time of 175 minutes [9]. In the Papaconstantinou, et al. the study showed that operating time was equal between the two groups, where the average operating time was 144 minutes [12]. In our study, the average operating time was 160.5±75.5 (140-300) minutes, which was longer than Papaconstantinou, et al. since there were 17 left hemi-colectomies (14.9%), 13 sigmoidectomies (11.4%), and 19 converted cases in our study, where the operating time was long. In contrast, there was no left hemi-colectomy in the study of Papaconstantinou, et al. [12]. The average operating time in SP laparoscopic group of C.G. Huscher [8] was 147±61 minutes, which may be related to the high rate of cancer stage 1 and 2 (12/16), accounting for the shorter operating time compared to our study. According to T. William, et al. [9], SP laparoscopy should be performed by experienced surgeons in laparoscopic surgery, and when this technique becomes routine, the time factor is no longer different between the two techniques. We also found that our operating time was shorter in the latter half of our series.

There were 19 conversions (16.7%) to open surgery in our study. The conversion rate in our study was higher than several other studies. The comparative study of William Tzu-Liang Chen, et al. [9] had three cases of conversion (3/18), where one case was of open surgery, and 2 cases were of traditional laparoscopy. In the study by Papaconstantinou, et al., 26 patients in SP laparoscopic group had 3 conversions, where two cases were converted to traditional laparoscopy and one to open surgery [12]. This even suggests that the selection of patients with low BMI and small tumor size is very important for SP laparoscopy. The reasons for conversion in our study were tumor invasion to adjacent organs (12/19 cases) and peri-tumor inflammation (7/19). In cases of peri-tumor inflammation, we added first additional port in RLQ or LLQ. If no progress was apparent, we converted to open surgery. We have been successful in 5 cases. In tumor invasion situations, we decided to convert to open surgery immediately without adding more ports.

In the studies of A. Keshava, et al. [6] and William Tzu-Liang Chen, et al. [9], the average incision length was of 4 cm (3-6). In our study, the average incision length was 5.5±2.2 cm (4-10). We discerned, our incision was longer because several tumors in our study were of a bigger size, and so, we had to extend the incision to extract these tumors. In the studies of William Tzu-Liang Chen, et al. [9], the average tumor size was 2 cm (0.5-6), but for our study, it was 3.7±2.7 cm (3-8).

Only 2 cases in SP laparoscopic group of William Tzu-Liang Chen, et al.'study [9] had complications related to surgery, and no cases needed re-intervention. Research by B. Peter, et al. on 50 cases of SP laparoscopy had one case of anastomotic leakage and 4 cases of abdominal incision infection [1]. A study of 22 cases of right SPLC by A. Keshava, et al. (BMI 27) had 2 cases of re-intervention [6]. Our study had five cases of complications, including 4 cases of wound infection and one case of anastomotic leakage that required re-intervention. Thus, our rate of complications was similar to studies by other authors and not a risk factor for SP laparoscopy.

In our study, other results such as postoperative pain, bowel movement return, length of hospital stay were similar to the results of conventional laparoscopy [2].

Until recently, all four studies comparing SP laparoscopy with conventional laparoscopy showed that SP laparoscopy was feasible and safe, in both technical terms as well as oncological terms. However, these studies are yet to see any other outstanding advantages of SP laparoscopy as compared to conventional laparoscopy, except aesthetically [8, 9, 12, 17]. Only a comparative study by J.T. Poon, et al. on 50 patients recorded that SP laparoscopy had lesser postoperative pain and shorter hospital stay; however, the authors did not affirm the conclusions since the number of patients was small [17].

The results of postoperative follow-up had an average of 32.2±7,5 (3-65) months recorded. There was no incision hernia or metastasis. CEA ratio above 5 ng/ml was 21.9%, which is similar to the recognition of H.T. Papaconstantinou, et al. [12]. In our study, 5 patients had local recurrences and 3 liver metastases. All patients in the group of open conversion were in stage IIIC. Thus, we concluded that the recurrence rate in our study was not related directly to SP laparoscopy.

Conclusions

SPLC in the treatment of colon cancer is feasible, and safe. The cosmetic value is better (shorter incision, hidden

by umbilicus). Other results are similar to conventional laparoscopy.

However, a large number of patients are required accurate assessment of the long-term results, particularly in terms of oncology.

REFERENCES

[1] B. Peter, B. Van den, S. Colin (2011), "Single-incision laparoscopic colorectal surgery, experience with 50 consecutive cases", *J. Gastrointest. Surg.*, **15**, pp.1989-1994.

[2] Nhu Hiep Pham, Huu Thien Ho, Anh Vu Pham, Hai Thanh Phan (2012), "Study on results of laparoscopic colectomy for right-sided colon cancer", *Vietnam Journal of Endolaparoscopic Surgeons*, **2(1)**, pp.115-118.

[3] T. Makino, J.W. Milsom, S.W. Lee (2012), "Feasibility and safety of single-incision laparoscopic colectomy: a systematic review", *Ann. Surg.*, **255**, pp.667-676, [PMID: 22258065, doi:10.1155/2012/783074].

[4] P. Bucher, F. Pugin, P. Morel (2009), "Single-port access laparoscopic radical left colectomy in humans", *Diseases of the Colon & Rectum*, **52**, pp.1797-1801, [PMID: 19966617, doi: 10.1007/DCR.0b013e3181b551ce].

[5] I. Ahmed, P. Paraskevas (2011), "A clinical review of single-incision laparoscopic surgery", *The Surgeon*, **9**, pp.341-351.

[6] A. Keshava, C.J. Young, S. Mackenzie (2010), "Single-incision laparoscopic right hemicolectomy", *British Journal of Surgery*, **97**, pp.1881-1883.

[7] A.K. Fung, E.H. Aly (2012), "Systematic review of single-incision laparoscopic colonic surgery", *British Journal of Surgery*, **99**, pp.1353-1364.

[8] G. Huscher Cristiano, A. Mingoli (2012), "Standard laparoscopic versus single-incision laparoscopic colectomy for cancer: early results of a randomized prospective study", *The American Journal of Surgery*, **204**, pp.115-120.

[9] William Tzu-Liang Chen, Sheng-Chi Chang, Hua-Che Chiang, Wan-Yu Lo, Long-Bin Jeng, Christina Wu, Tao-Wei Ke (2011), "Single-incision laparoscopic versus conventional laparoscopic right hemicolectomy: a comparison of shortterm surgical results", *Surg. Endosc.*, **25**, pp.1887-1892.

[10] S. Tsujinaka, F. Konishi, Y.J. Kawamura, M. Saito, N. Tajima, O. Tanaka, A.T. Lefor (2008), "Visceral obesity predicts surgical outcomes after laparoscopic colectomy for sigmoid colon cancer", *Diseases of the Colon & Rectum*, **51**, pp.1757-1765, [PMID: 18600376, doi: 10.1007/s10350-008-9395-0].

[11] I. Diego, V. Ramos, B.P. Chirag (2010), "Single-incision laparoscopic right hemicolectomy: safety and feasibility in a series of consecutive cases", *Surg. Endosc.*, **24**, pp.2613-2616.

[12] H.T. Papaconstantinou, J.S. Thomas (2011), "Single-incision laparoscopic colectomy for cancer: Assessment of oncologic resection and short-term outcomes in a case-matched comparison with standard laparoscopy", *Surgery*, **150**, pp.820-827.

[13] L. Boni, G. Dionigi, E. Cassinotti, M. Di Giuseppe, M. Diurni, S. Rausei, F. Cantore, R. Dionigi (2010), "Single incision laparoscopic right colectomy", *Surg. Endosc.*, **24**, pp.3233-3236.

[14] D. Escribano Carlos, V. Fernandez Cristina, D.C. Diez Federico (2011), "Single port access surgery in colorectal disease: preliminary results", *Cir. Esp.*, **89**, pp.588-594.

[15] W.L. Law, J.K. Fan, J.T. Poon (2010), "Single incision laparoscopic left colectomy for carcinoma of distal transverse colon", *Colorectal Dis.*, **12**, pp.698-701, [PMID: 19895602 doi: 10.1111/ j.1463-1318.2009.02114.x].

[16] F. Leblanc, B.J. Champagne, K.M. Augestad (2010), "Single Incision Laparoscopic Colectomy: Technical Aspects, Feasibility, and Expected Benefits", *Diagnostic and Therapeutic Endoscopy*, **2010**, pp.1-6.

[17] J.T. Poon, C.W. Cheung, J.K. Fan, O.S. Lo, W.L. Law (2012), "Single-incision versus conventional laparoscopic colectomy for colonic neoplasm: a randomized, controlled trial", *Surg. Endosc.*, **26**, pp.2729-2734.