

# Outcomes of Single-Incision Laparoscopic Surgery for Colon Cancer: A Case-Matched Comparative Study

Atthaphorn Trakarnsanga, M.D., Thawatchai Akaraviputh, M.D., Chotirot Angkurawaranon, M.D., Chanin Pandee, M.D., Natthawut Photong, M.D., Voraboot Taweeruchana, M.D., Thammawat Parakonthun, M.D., Chainarong Phalanusitthepa, M.D., Jirawat Swangsri, M.D., Asada Methasate, M.D., Thanyadej Nimmanwudipong, M.D., Vitoon Chinswangwatanakul, M.D.

Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

## ABSTRACT

**Background:** Single-incision laparoscopic colectomy (SILC) is an evolving technique with potential advantages by reducing number of incisions that can reduce port-related complications and improve cosmetic results. The purpose of this study was to compare the short-term outcomes between SILC, hand-assisted laparoscopic colectomy (HALC) and standard multi-port laparoscopic colectomy (MLC).

**Methods:** Retrospective analyses of a total of 90 patients between May 2010 and December 2011, who underwent SILC for colon cancer surgery, were performed in 30 patients. Clinicopathological parameters were matched 1:1 with patients who underwent HALC (n=30) and MLC (n=30). Short-term outcomes were collected and analyzed.

**Results:** Operative time was significantly shorter in SILC compared to HALC and MLC ( $p < 0.001$ ), as well as less estimated blood loss ( $p = 0.02$ ). There were no significant differences in conversion rate and number of harvested lymph nodes. SILC had the advantage of less 24-hr postoperative pain score compared to HALC and MLC ( $p < 0.001$ ), whereas length of stay and time to full diet were not different.

**Conclusion:** In selected patients, SILC can be successfully and safely performed with shorter operative time, less estimated blood loss and less postoperative pain score.

**Keywords:** Single-incision laparoscopic colectomy, single-port laparoscopic colectomy, hand-assisted laparoscopic colectomy, laparoscopic colectomy, colon cancer

Siriraj Med J 2016;68:104-108

E-journal: <http://www.sirirajmedj.com/ojs>

## INTRODUCTION

### Background

Since the first published case series of laparoscopic surgery in the 1990's by Jacobs, et al,<sup>1</sup> the improvements in short-term outcomes and safety of this minimally invasive

technology for colorectal cancer has been proven from several prospective randomized controlled trials.<sup>2-7</sup> The long-term results are comparable between laparoscopic colectomy and open colectomy for colon cancer, including recurrences and survivals.<sup>2-5</sup> Therefore, these are the main reasons for increasing popularity of laparoscopic colectomy for colon cancer.

The use of laparoscopic surgery has had a significant impact on recent surgical procedures in many fields counting colorectal surgery as well. Several techniques have been proposed, including standard multi-port laparoscopic colectomy,

Correspondence to: Thawatchai Akaraviputh  
E-mail: [Thawatchai.aka@mahidol.ac.th](mailto:Thawatchai.aka@mahidol.ac.th), [Akaraviputh@gmail.com](mailto:Akaraviputh@gmail.com)  
Received 4 March 2016  
Revised 25 March 2016  
Accepted 4 April 2016

Hand-assisted laparoscopic colectomy (HALC), Single-Incision laparoscopic surgery (SILC) and robotic assisted laparoscopic colectomy. SILC is an evolving technique with potential advantages by reducing the number of incisions that can reduce port-related complications and improve cosmetic results.<sup>8-10</sup> One of the major disadvantages of SILC is collision of the instruments causing limitation of movement. This may prolong the operative time. However, some studies demonstrated the benefit of SILC was not only limited to cosmetic outcome, but also shorter operative time and shorter length of stay.<sup>9,11</sup> Therefore, the purpose of this recent study compares the results of intraoperative and postoperative outcomes between SILC, HALC and MLC.

## MATERIALS AND METHODS

### *Study population*

After the Institutional Review Board approved this study, a retrospective analysis of the patients who underwent SILC, HALC, and MLC at Minimally Invasive Surgery Unit, the Department of Surgery, Faculty of Medicine Siriraj Hospital between May 2010 and December 2011 was performed. Patient's demographic data, perioperative outcomes, early postoperative complications and pathological data were recorded.

### *Operative techniques*

#### **Positioning**

#### **Right hemicolectomy**

Patient was placed in supine position and operating table was turned into steep trendelenburg and right side up position. Surgeon stayed on the left side of the patient accompanied with camera holder. The assistant and scrub nurse stayed on the opposite site.

#### **Left hemicolectomy and sigmoidectomy**

Modified lithotomy position was preferable position for left-sided lesion. Steep trendelenburg and left side up were positioned after operative ports were completely placed. Surgeon, camera holder and scrub nurse stayed on the right side and assistant stayed on the left side of the patient.

### **Single incision laparoscopic colectomy**

We used multi-fascial technique similar to our previous publication.<sup>12</sup> Majority of the cases (N=27) used this technique by making a small 4-5 cm midline incision through skin and subcutaneous tissue. Pneumoperitoneum was created with closed technique by puncturing with Veress needle into intraperitoneal cavity. A 10-mm port was inserted to abdominal cavity for a 10-mm, 30-degree camera (Endoeye™, Olympus comp. Tokyo, Japan). Two 5-mm ports were placed at the upper and lower end of incision for standard non-articulating instruments, including monopolar endohook, ultrasonic device, and non-traumatic grasper.

### **Mesenteric dissection**

Medial to lateral approach is a preferable technique for both-sided lesions. After controlling of named vessels by clips, mobilization of the lateral attachment was performed to free the affected colon. Exteriorization of the colon was performed via hand-port device for HALC, while fascial extension was needed for SILC and MLC. Resection of the tumor and completion of the anastomosis by hand-sewn or stapling devices were performed.

### *Statistical analysis*

Statistical analyses were performed using PASW Statistics, version 18.0 (SPSS Inc, Chicago, IL). The chi-square and student t tests were used to compare the data for each group. *P* less than 0.05 was considered statistically significant.

## RESULTS

Between May 2010 and December 2011, 30 SILC were performed for colon cancer surgery and were case matched with 1:1 with patients who underwent HALC (n=30) and MLC (n=30). Nine (30%) patients in SILC group had previous abdominal operations and were not significantly difference with HALC (13%) and MLC (30%) (*p*= 0.22) groups. One of the patients of SILC was converted to HALC (3%), slightly lower when compared with two patients (6%) in HALC and 4 patients (12%) in MLC groups. Demographic

data were presented in Table 1. Intraoperative outcomes were presented in Table 2 and post-operative outcomes were presented in Table 3.

## DISCUSSION

HALC has potential benefits with shorter learning curve for the performer, less operative time and lower conversion rate compared to conventional laparoscopic colectomy, especially in the setting of complex procedures such as total proctocolectomy.<sup>13-15</sup> SILC, also known as single-port laparoscopic colectomy (SPLC), is an evolving technique with potential advantages by reducing the number of incisions which can reduce port-related complications and improve cosmetic results.<sup>8-10</sup> The reports of the learning curve for SILC ranged between 10-36 cases.<sup>16,17</sup>

Recent systematic reviews and meta-analysis have compared the results of SILC to standard MLC. The majority of the results concurred on comparable results in the post-operative complications, conversion rate, operative time, blood

loss, ileus, length of hospital stay, morbidity and mortality.<sup>8,9,18-20</sup> Yang and colleagues found the advantage of decreased length of stay, less incision length, and less blood loss with increased number of harvested lymph nodes.<sup>19</sup>

A couple of case-matched studies compared the results of SILC to HALC and MLC<sup>21,22</sup> found that SILC was comparable to MLC in safety and operative time with the advantage of decreased incision length, and suggesting improved cosmetic satisfaction, along with increase in patient recovery time due to less post-operative pain and shorter length of stay.

For this recent study, the operative time was significantly shorter between SILC and HALC ( $p < 0.003$ ) as well as SILC and MLC ( $p < 0.001$ ). The shorter operative time may be due to the fact that the surgeons performing the SILC are well experienced with the HALC and the MLC. This result is similar to previous publications.<sup>10,11</sup> Therefore, the potential advantage is not limited only to cosmetic results, but also includes shorter operative time.

**TABLE 1.** Baseline characteristics.

	SILC (30)	HALC (30)	MLC (30)	P value
Gender: Female to male	15:15	15:15	19:11	0.49
Age(y): Mean $\pm$ SD	64 $\pm$ 14	67 $\pm$ 13.1	65 $\pm$ 11.5	0.74
Body mass index (kg/m <sup>2</sup> ), Mean $\pm$ SD	23.82 $\pm$ 4.5	22.64 $\pm$ 3.5	23.08 $\pm$ 3.2	0.48
ASA score				
1	4	5	5	0.89
2	24	21	21	
3	2	4	4	
Previous abdominal operation, n (%)	9 (30)	4 (13)	9 (30)	0.22
Location				
Right	7	3	7	0.06
Left	4	5	6	
Sigmoid	19	22	17	
T Stage				
0-2	10	10	11	0.95
3-4	20	20	19	
N Stage				
0	13	11	14	0.73
1-2	17	19	16	
Colonic stent, n (%)	3 (10)	2 (7)	2 (7)	0.36

**TABLE 2.** Intraoperative outcomes.

	<b>SILC (30)</b>	<b>HALC (30)</b>	<b>MLC (30)</b>	<b>P value</b>
Operative time (min), Median (range)	120 (60-260)	180 (90-300)	208 (95-360)	<0.001*
Estimated blood loss (ml), Median (range)	25 (5-300)	50 (5-400)	50 (5-350)	0.02**
Conversion, n (%)	1 (3)	2 (6)	4 (12)	0.49
Lymph node harvest, Median (range)	16 (0-46)	18 (3-58)	22 (4-46)	0.33
Anastomosis Hand / staple	9 / 21	9 / 21	5 / 25	0.39

\*Operative time for SILC vs. HALC (p= 0.003), SILC vs. LAC (p<0.001)

\*\*Estimated blood loss for SILC vs. HALC (p= 0.02)

**TABLE 3.** Postoperative outcomes.

	<b>SILC (30)</b>	<b>HALC (30)</b>	<b>MLC (30)</b>	<b>P value</b>
Length of stay (day), Mean ± SD	8 ± 3.4	8 ± 3.2	7 ± 3.1	0.73
Pain score at 24 hr, Median (range)	2 (0-6.6)	5 (2-8)	2 (0-4.2)	<0.001*
Time to fully diet (hr), Median (range)	64 (28-112)	72 (48-96)	67 (38-112)	0.29
Leakage, n (%)	1 (3)	0 (0)	0 (0)	N/A**

\*Pain score at 24 hr. for SILC vs. HALC (p< 0.001) and HALC vs. MLC (p <0.001)

\*\*The number of event is too small to calculate by statistical analysis

## CONCLUSION

In selected patients, SILC can be successfully and safely performed with shorter operative time, less estimated blood loss and less post-operative pain score. However, a large randomized study will be crucial to determine the data of short-term and long-term oncological outcomes.

### Competing interests

The author(s) declare that they have no competing interests.

### ACKNOWLEDGMENTS

Presented at 21<sup>st</sup> International Congress of the European Association Endoscopic Surgery (EAES), Vienna, Austria, June 19-22, 2013. This

study was supported by the Research Grant of Faculty of Medicine Siriraj Hospital, Mahidol University.

### REFERENCES

1. Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). *Surg Laparosc Endosc* 1991;1:144-50.
2. Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taura P, Pique JM, et al. Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. *Lancet*. 2002;359:2224-9.
3. Clinical Outcomes of Surgical Therapy Study G. A comparison of laparoscopically assisted and open colectomy for colon cancer. *N Engl J Med* 2004;350:2050-9.

4. Colon Cancer Laparoscopic or Open Resection Study G, Buunen M, Veldkamp R, Hop WC, Kuhry E, Jeekel J, et al. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcome of a randomised clinical trial. *Lancet Oncol* 2009;10:44-52.
5. Jayne DG, Thorpe HC, Copeland J, Quirke P, Brown JM, Guillou PJ. Five-year follow-up of the Medical Research Council CLASICC trial of laparoscopically assisted versus open surgery for colorectal cancer. *Br J Surg* 2010;97:1638-45.
6. Kang SB, Park JW, Jeong SY, Nam BH, Choi HS, Kim DW, et al. 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* 2010;11:637-45.
7. van der Pas MH, Haglind E, Cuesta MA, Furst A, Lacy AM, Hop WC, et al. Laparoscopic versus open surgery for rectal cancer (COLOR II): short-term outcomes of a randomised, phase 3 trial. *Lancet Oncol* 2013;14:210-8.
8. Fung AK, Aly EH. Systematic review of single-incision laparoscopic colonic surgery. *Br J Surg* 2012;99:1353-64.
9. Maggiori L, Gaujoux S, Tribillon E, Bretagnol F, Panis Y. Single-incision laparoscopy for colorectal resection: a systematic review and meta-analysis of more than a thousand procedures. *Colorectal Dis* 2012;14:e643-54.
10. Makino T, Milsom JW, Lee SW. Feasibility and safety of single-incision laparoscopic colectomy: a systematic review. *Ann Surg* 2012;255:667-76.
11. Gaujoux S, Maggiori L, Bretagnol F, Ferron M, Panis Y. Safety, feasibility, and short-term outcomes of single port access colorectal surgery: a single institutional case-matched study. *J Gastrointest Surg* 2012;16:629-34.
12. Trakarnsanga A, Akaraviputh T, Wathanaoran P, Phalanusitthepha C, Methasate A, Chinswangwattanakul V. Single-incision laparoscopic colectomy without using special articulating instruments: an initial experience. *World J Surg Oncol* 2011;9:162.
13. Aalbers AG, Biere SS, van Berge Henegouwen MI, Bemelman WA. Hand-assisted or laparoscopic-assisted approach in colorectal surgery: a systematic review and meta-analysis. *Surg Endosc* 2008;22:1769-80.
14. Meshikhes AW. Controversy of hand-assisted laparoscopic colorectal surgery. *World J Gastroenterol* 2010;16:5662-8.
15. Cima RR, Pendlimari R, Holubar SD, Pattana-Arun J, Larson DW, Dozois EJ, et al. Utility and short-term outcomes of hand-assisted laparoscopic colorectal surgery: a single-institution experience in 1103 patients. *Dis Colon Rectum* 2011;54:1076-81.
16. Haas EM, Nieto J, Ragupathi M, Aminian A, Patel CB. Critical appraisal of learning curve for single incision laparoscopic right colectomy. *Surg Endosc* 2013;27:4499-503.
17. Hopping JR, Bardakcioglu O. Single-port laparoscopic right hemicolectomy: the learning curve. *JLS* 2013;17:194-7.
18. Li P, Wang DR, Wang LH, Li YK, Chen J. Single-incision laparoscopic surgery vs. multiport laparoscopic surgery for colectomy: a meta-analysis of eleven recent studies. *Hepatogastroenterology* 2012;59:1345-9.
19. Yang TX, Chua TC. Single-incision laparoscopic colectomy versus conventional multiport laparoscopic colectomy: a meta-analysis of comparative studies. *Int J Colorectal Dis* 2013;28:89-101.
20. Vettoretto N, Cirocchi R, Randolph J, Parisi A, Farinella E, Romano G. Single incision laparoscopic right colectomy: a systematic review and meta-analysis. *Colorectal Dis* 2014;16:O123-32.
21. Lee SW, Milsom JW, Nash GM. Single-incision versus multiport laparoscopic right and hand-assisted left colectomy: a case-matched comparison. *Dis Colon Rectum* 2011;54:1355-61.
22. Papaconstantinou HT, Sharp N, Thomas JS. Single-incision laparoscopic right colectomy: a case-matched comparison with standard laparoscopic and hand-assisted laparoscopic techniques. *J Am Coll Surg* 2011;213:72-80.