



Single-Incision Laparoscopic Appendectomy (SILA) in Patients Aged Over 80 Years: A Single Centre Experience

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Abstract

Background: The goals of this study are to evaluate the advantage and disadvantage of single-incision laparoscopic appendectomy in super-elderly (≥ 80) patients.

Methods: Of the elderly (≥ 65) patients underwent appendectomy total 81 patients were reviewed in this study. The patients divided into three groups: open appendectomy in super-elderly patients groups (32 patients), single-incision laparoscopic appendectomy in super-elderly patients groups (15 patients) and single-incision laparoscopic appendectomy in elderly patients groups (34 patients). Demographic and clinical features, operative findings, and postoperative complications were retrospectively compared among the three groups.

Results: In the single-incision laparoscopic appendectomy in super-elderly patients groups and single-incision laparoscopic appendectomy in elderly patients groups, the postoperative gas passage and voiding difficulty showed significant differences ($p=0.015$ and $p=0.004$), respectively. Otherwise, operation time, postoperative complications except voiding difficulty did not differ significantly among three groups.

Conclusion: These outcomes indicate that single-incision laparoscopic appendectomy in patient's ≥ 80 years can be done safely and one of the accepted procedures for acute appendicitis.

Keywords: Single-incision laparoscopic surgery; Laparoscopic appendectomy; Super-elderly patient; Acute appendicitis; Octogenarians

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Introduction

Acute appendicitis is one of the most common diseases that require emergency surgery, and many new operative techniques have been attempted to date. And much advancement has occurred in surgical techniques with more studies currently underway. Since its introduction in 1983, conventional three-port laparoscopic appendectomy has become a standard procedure for treating acute appendicitis [1]. In the 1990s, when patients became more interested in the cosmetic results of surgery, Single-Incision Laparoscopic Appendectomy (SILA) was introduced [2].

Meanwhile, because of the longer life expectancy that results from socioeconomic growth and medical advances, the proportion of elderly people is gradually increasing worldwide; accordingly, the prevalence of elderly appendicitis is expected to increase. In South Korea, elderly patients (≥ 65 years) comprised 12.7% of the total population in 2014, and this proportion continues to increase. By 2030, it will represent almost one-quarter of the total population [3].

Due to recent demographic changes and trends in the use of laparoscopic surgery for appendicitis, increasing numbers of elderly patients are undergoing laparoscopic appendectomy. Many studies have investigated the results of laparoscopic appendectomy, showing shorter hospitalization period and lower morbidity and mortality rates than open appendectomy for elderly patients (≥ 65 years) [4-6]. In a study of appendicitis in super-elderly patients (≥ 80 years), most patients underwent open appendectomy (90%), while the rest underwent laparoscopic appendectomy (10%), and the researchers emphasized the importance of aggressive diagnostic intervention, appropriate surgery, and preventing pulmonary complications [7]. On the other hand, Park et al reported that antibiotic therapy without surgery may be a safe and effective treatment for appendicitis in selective patient's

Table 1: Comparison of demographics.

	SILA-80	OA-80	SILA-65	P-value	
	(n=15)	(n=32)	(n=34)	SILA-80 vs. OA-80	SILA-80 vs. SILA-65
Age(yr), mean \pm SD	83.6 \pm 2.6	82.6 \pm 2.6	69.06 \pm 4.3	NS	0
Male/female ratio	10:5 (2:1)	26:6 (4.33:1)	30:4 (7.5:1)	NS	NS

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; SD: Standard Deviation; NS Not Significant

Table 2: Comparison of underlying disease.

	SILA-80	OA-80	SILA-65	P-value	
	(n=15)	(n=32)	(n=34)	SILA-80 vs.OA-80	SILA-80 vs.SILA-65
Cardiac disease	2(13.3)	5(15.6)	6(17.6)	NS	NS
Hypertension	12(80)	19(59.4)	20(58.8)	NS	NS
Diabetes mellitus	4(26.7)	2(6.3)	8(23.5)	0.051	NS
Liver disease	0(0)	1(3.1)	0(0)	NS	-
Cerebrovascular disease	1(6.7)	7(21.9)	6(17.6)	NS	NS
Pulmonary disease	2(13.3)	2(6.3)	8(23.5)	NS	NS
Chronic renal failure	3(20)	0(0)	2(5.9)	0.009	NS
Dementia	0(0)	3(9.4)	0(0)	NS	-
Benign prostatic hypertrophy	5(33.3)	5(15.6)	4(11.8)	NS	NS
Malignancy	2(13.3)	5(15.6)	6(17.6)	NS	NS

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; NS: Not Significant; Values are presented as number (%)

\geq 80 years of age [8].

Our hospital has been starting SILA in 2010. From 2012, SILA has been performed in almost all but super-elderly patients with appendicitis. Moreover, since our hospital treats many elderly patients, SILA has been performed even in patients aged \geq 80 years since 2013 as long as there are no contraindications; as such, the numbers of these patients are increasing. However, controversy persists regarding the use of SILA in super-elderly patients, and literature review revealed no studies evaluating the outcomes of SILA in this population.

The goals of this study are to: (1) evaluate the advantages and disadvantages of SILA in super-aged patients who underwent appendectomy due to acute appendicitis; (2) ascertain whether SILA is safe in super-elderly patients; and (3) evaluate the applicability of SILA in this population.

Materials and Methods

This study received approval from the Gwangju Veterans Hospital ethical committee.

We performed 751 appendectomies in the department of surgery between January 2010 and June 2014; of them, super-elderly patients (\geq 80 years) were 51. Of those 51 patients, four who underwent an incidental appendectomy were excluded, so finally total 47 patients were selected for this study. Because routine laparoscopic appendectomy in patient's \geq 80 years began after SILA was established as the standard procedure for just about all cases in our hospital, there were no cases of three-port appendectomy in super-elderly patients. The subjects were divided into the open appendectomy group (OA-80) and the SILA group (SILA-80).

During the same period, a total of 128 elderly patients (65-79 years) underwent an appendectomy. Of the 128 patients, 78 who underwent an open appendectomy and 16 patients who underwent a

three-port appendectomy were excluded, so a total of 34 patients who underwent SILA were selected (SILA-65). To analyze the difference between open appendectomy and SILA in the same age groups, the OA-80 and SILA-80 groups were compared; to analyze the age-based differences in patients who underwent SILA, the SILA-80 and SILA-65 groups were compared.

Age, sex, underlying diseases, American Society of Anesthesiologists (ASA) score, diagnostic method, blood test findings, presence of abscess drainage, operative time, pathological findings, postoperative day of hospital stay, time to gas passage and liquid diet intake, number of analgesics used, and complications were retrospectively compared among the three groups.

Surgery was performed by three general surgeons. All operations were performed under general anesthesia. Open appendectomy was performed using a common technique. SILA was performed using the GelPOINT Advanced Access Platform (Applied Medical, Santa Margarita, CA) that was inserted directly under the umbilicus. The pedicle of the appendix was dissected using Liga Sure™ 5mm blunt tip (Covidien/Medtronic, Ireland). The base of the appendix was ligated with Lap loop. If drain is needed a Jackson Pratt drainage tube was inserted into the pelvic cavity through the right abdominal wall.

All analyses were performed using SPSS software version 19.0 (IBM, Chicago, IL, USA). Student t test was used to test the differences in mean values for the continuous variables (age, leukocyte count, operation time, length of hospital stay, the time to gas passage, etc.). The Chi square test was used to evaluate the differences in categorical variables (sex, underlying disease, presence of abscess drainage, etc.). Values of $P < 0.05$ were considered statistically significant.

Results

Each of the three groups had more male than female patients, but there were no statistically significant differences between the groups

Table 3: Comparison of diagnostic tools, leukocytosis and signs.

	SILA-80	OA-80	SILA-65	P-value	
	(n=15)	(n=32)	(n=34)	SILA-80 vs. OA-80	SILA-80 vs. SILA-65
Physical examination	0(0)	10(31.2)	2(5.9)	0.015	NS
US	5(33.3)	11(34.4)	12(35.3)	NS	NS
APCT	10(66.7)	11(34.4)	20(58.8)	0.022	NS
Leukocytosis (>10,000/mm ³)	6(40.0)	16(50.0)	6(17.6)	NS	NS
WBC(/mm ³)	9112.0 ± 4233.1	10304 ± 3865.3	7758 ± 2349.6	NS	NS
RLQ tenderness	13(86.7)	32(100)	34(100)	0.035	NS
RLQ rebound tenderness	8(53.3)	29(90.6)	32(94.1)	0.004	0.008

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; SD: Standard Deviation; NS: Not Significant; US: Ultra Sonography; APCT: Abdominopelvic Computerized Tomography; RLQ: Right Lower Quadrant; Values are presented as number (%)

Table 4: Comparison of operation.

	SILA-80	OA-80	SILA-65	P-value	
	(n=15)	(n=32)	(n=34)	SILA-80 vs. OA-80	SILA-80 vs. SILA-65
ASA score	2.20 ± 0.414	2.25 ± 0.440	1.76 ± 0.437	NS	0.007
Operation time (min)	42.73 ± 12.92	38.88 ± 20.22	41.18 ± 14.84	NS	NS
Drainage apposition	6(40)	13(40.6)	2(11.8)	NS	NS

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; ASA: American Society of Anesthesiologists; NS: Not Significant; Values are presented as number (%)

Table 5: Comparison of pathology.

	SILA-80	OA-80	SILA-65	P-value	
	(n=15)	(n=32)	(n=34)	SILA-80 vs. OA-80	SILA-80 vs. SILA-65
Focal	4 (26.7)	7 (21.9)	16 (47.1)	NS	NS
Suppurative	6 (40.0)	8 (25.0)	14 (41.2)	NS	NS
Gangrenous	1 (6.7)	3 (9.4)	0 (0)	NS	NS
Perforative	1 (6.7)	3 (9.4)	2 (5.9)	NS	NS
Abscess	3 (20.0)	11 (34.4)	2 (5.9)	NS	NS

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; NS: Not Significant; Values are presented as number (%)

(Table 1). However, while the male-to-female ratio in the SILA-65 group was 7.5:1, the sex ratio in the SILA-80 and OA-80 groups was 2:1 and 4.3:1, respectively, which indicates an increased proportion of women in the SILA-80 and OA-80 groups.

Underlying diseases by group were compared. The number of patients with diabetes mellitus and chronic renal failure was higher in the SILA-80 group than in the OA-80 group (Table 2). However, the number of patients with cardiac disease, hypertension, liver disease, cerebrovascular disease, dementia, benign prostatic hypertrophy, and malignancy did not differ between the groups. The SILA-80 and OA-65 groups did not exhibit statistically significant differences in underlying diseases.

In the OA-80 group, physical examination, Ultrasonography (US), and abdominopelvic Computed Tomography (CT) were used in similar proportions for the diagnosis of acute appendicitis, with the percentage of diagnosis by physical examination alone reaching 31.2% (Table 3). In contrast, appendicitis was not diagnosed by physical examination alone in the SILA-80 group, but by CT in most cases (66.7%) and by US in one-third of the patients. Diagnostic methods showed statistically significant differences between the two groups. The SILA-65 group showed similar percentages of the use of

diagnostic methods as the SILA-80 group, but the differences were not statistically significant (Table 4).

The SILA-80 and SILA-65 groups showed a significant difference in ASA score ($p=0.007$), but there was no difference between the SILA-80 and OA-80 groups. The mean operation time of SILA-80 group (42.73 ± 12.92 min.) was longer than OA-80 group (38.88 ± 20.22 min.) but similar compared with SILA-65 group (41.18 ± 14.84 min.). No statistically significant differences were observed among the three groups. The presence of drainage insertion in the SILA-80 group was similar compared with OA-80 group, being 40% and 40.6%, respectively. But the presence of drainage insertion in the SILA-65 group (11.8%) was lower than SILA-80 group. There were no differences among the three groups. Based on the pathological findings, acute appendicitis was classified into five types: focal, suppurative, gangrenous, and perforated appendicitis; and periappendiceal abscess. Comparison of the three groups revealed no significant differences in histopathological findings (Table 5).

Postoperative gas passage occurred at an average of 1.18 ± 0.393 postoperative days in the SILA-65 group compared to 1.67 ± 0.617 postoperative days in the SILA-80 group, a difference that was statistically significant ($p = 0.015$). However, there was no significant

Table 6: Comparison of gas passage, time to liquid diet, postoperative hospital stay and analgesic use.

	SILA-80	OA-80	SILA-65	P-value	
				SILA-80 vs. OA-80	SILA-80 vs. SILA-65
Gas passage (postoperative day)	1.67 ± 0.617	1.50 ± 0.718	1.18 ± 0.393	NS	0.015
Time to liquid diet (postoperative day)	1.07 ± 0.258	1.53 ± 1.64	1.06 ± 0.243	NS	NS
Frequency of analgesic use (time)	1.93 ± 1.33	1.91 ± 2.00	1.31 ± 1.41	NS	NS
Postoperative Hospital stay (day)	9.27 ± 3.45	11.03 ± 7.80	8.24 ± 4.17	NS	NS

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; NS: Not Significant; Values are presented as mean ± standard deviation

Table 7: Comparison of postoperative complications.

	SILA-80 (n=15)	OA-80 (n=32)	SILA-65 (n=34)	P-value	
				SILA-80 vs. OA-80	SILA-80 vs. SILA-65
Wound infection	0 (0)	1 (3.1)	2 (5.9)	NS	NS
Pneumonia	0 (0)	5 (15.6)	0 (0)	NS	-
Atelectasis	2 (13.3)	7 (21.9)	6 (17.6)	NS	NS
Voiding difficulty	6 (40.0)	11 (34.4)	0 (0)	NS	0.004
Intra abdominal abscess	0 (0)	0 (0)	0 (0)	-	-

SILA-80: Single Incision Laparoscopic Appendectomy in super-elderly patients group; OA-80: Open Appendectomy in super-elderly patients group; SILA-65: Single Incision Laparoscopic Appendectomy in elderly patients group; NS: Not Significant; Values are presented as number (%)

difference between the SILA-80 and OA-80 group. Time to liquid diet intake was shorter in the SILA-80 group than OA-80 group, being 1.07 ± 0.258 postoperative days and 1.53 ± 1.64 postoperative days, respectively, but the difference between the two groups was not significant. Time to liquid diet intake did not differ significantly between the SILA-80 group and SILA-65 group. The frequency of analgesic use, and postoperative hospital stay did not differ significantly among the three groups (Table 6).

The incidence of voiding difficulty was significantly high in SILA-80 group than in the SILA-65 group (p=0.004). But the voiding difficulty between SILA-80 group and OA-80 group did not differ significantly (Table 7). There was no intra abdominal abscess in the three groups. There was postoperative pneumonia only in the OA-80 group (15.6 %), but not in the SILA-80 and SILA-65 group, with no significant differences among the three groups. The frequencies of wound infection and atelectasis did not differ significantly among the three groups (Table 7).

Discussion

The results of this study demonstrate no significant difference in terms of surgical outcome and postoperative complications of SILA-80 group when compared to OA-80 and SILA-65 groups.

The mean operation time of SILA-80 group was longer than OA-80 group but similar compared with SILA-65 group. No statistically significant differences were observed among the three groups. This is the first study that evaluated outcomes of SILA vs. OA in the super-elderly patients, so there was no literature that compare with the results of this study. However, in the study that evaluated the results of laparoscopic appendectomy and open appendectomy in older patients, there were no significant differences of mean operation time between the two groups [9,10]. And, the study that evaluated outcomes of SILA and conventional three port appendectomy showed no significant difference in the mean operation time between the two groups [11]. Based on these studies, it is presumed that there is no difference significantly in the mean operation time between the SILA-80 group and the OA-80 group. However, other researchers reported that the mean operation time of conventional three port

appendectomy group was longer than single incision laparoscopic appendectomy group, with statistically significant difference [12,13].

Although the presence of postoperative drainage did not differ significantly, it was higher in the SILA-80 and OA-80 groups than in the SILA-65 group. However, the SILA-80 and OA-80 groups showed similar rates of 40% and 40.6%, respectively, with no statistically significant difference.

The significant difference in ASA score seen between the SILA-80 and SILA-65 groups is thought to be due to differences in age, and since there was no significant difference between the SILA-80 and OA-80 groups, the risks associated with anesthesia can be viewed as similar. The patients were classified into five groups according to postoperative pathology results (Table 5). As a result, although there were no statistically significant differences, the groups of patients aged ≥ 80 years (SILA-80 and OA-80) showed a pattern of higher perforation rates (perforative appendicitis and abscess) than the SILA-65 group. And the perforation rates of SILA-80 group were higher than OA-80 group. This may be due to weak anti-inflammatory function of the mesentery [14]. The difference in ASA score and the perforation rates between SILA-80 group and OA-80 group means the severity of systemic disease is similar but the severity of appendicitis is not similar between the two groups. It is quite remarkable that SILA-80 did not show any increased rates of complication despite of high rate of perforation and high ASA score.

In terms of postoperative gas passage, time to liquid diet intake, frequency of analgesic use, and postoperative hospital stay, no significant difference were seen SILA-80 group and OA-80 group. However, with regard to postoperative hospital stay, the length of stay tended to be shorter in the SILA-80 group (9.27 ± 3.45 days) than in the OA-80 group (11.03 ± 7.80 days). Postoperative gas passage was statistically significantly longer in the SILA-80 group than the SILA-65 group (p=0.015). Contrary to this study, Moon et al report that there was no significant difference in postoperative gas out between elderly group (65 to 79 years) and super-elderly group (over 80 years) [7]. Time to liquid diet intake, frequency of analgesic use, and postoperative hospital stay, no significant differences were seen

between SILA-80 group and SILA-65 group.

The most common complication in the SILA-80 group was voiding difficulty, in which a significant difference was seen between the SILA-80 and SILA-65 groups ($p=0.004$). However the reported rates and types of common complications vary, additional studies are needed. Meanwhile, even for one larger incision or wound healing problems, which have been identified as shortcomings of SILA, the present study showed that SILA was possible with an incision ≤ 2 cm and that zero cases of wound infection occurred in the SILA-80 versus only one case in the SILA-65 group. As such, it is believed that incision size and wound healing are not shortcomings of SILA [15].

As people grow older, the number of underlying diseases typically increases. According to Moon et al., the percentage of elderly patients with underlying diseases is 45.5%, whereas that of super-elderly group patients is 60.7% [7]. However, there were no significant differences between the super-elderly (SILA-80 and OA-80) and elderly (SILA-65) groups in the present study. Among the super-elderly groups, the proportion of patients with diabetes mellitus and chronic renal failure was significantly higher in the SILA-80 group than in the OA-80 group (Table 2). Sivrikoz et al. [16] reported that patients with diabetes mellitus are at high risk of surgical wound infection and longer hospital stays than patients without diabetes mellitus [16]. However, according to the results of the present study, although there were more patients with diabetes mellitus in the SILA-80 group than in the OA-80 group, the frequencies of wound infection and hospital stay were lower in the former than in the latter (Table 7). This is likely due to the influence of variables other than diabetes mellitus.

This was a preliminary study on the usefulness of SILA, and its small number of cases and retrospective nature limit the power of its results. However, it is believed that undertaking a prospective study with random patient assignment without any evidence that the SILA-80 group has equivalent or better surgical outcomes than the OA-80 group would be unfavorable from a research ethics perspective. As such, the authors conducted a retrospective study using medical records and found that performing SILA in the super elderly group showed outcomes equivalent to those of OA. The present study was meaningful as a first step in the study of SILA in super-elderly patients. And Randomized controlled trials are required to clear the influence of selection bias in the future.

In conclusion, since the SILA-80 group did not show significant differences in surgical outcome or postoperative complications compared to the SILA-65 group and OA-80 group, SILA in patient ≥ 80 years can be valuable as a more advanced technique for aesthetic purposes and one of the accepted procedures for acute appendicitis.

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