Original Article

Single Port Laparoscopy Appendectomy versus Open Appendectomy, Prospective Randomized Study

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Objective: To evaluate complication after single port laparoscopic appendectomy [SPLA] compare with open appendectomy [OA] in patients diagnosed acute appendicitis.

Materials and Methods: The present study enrolled 172 patients diagnosed as acute appendicitis at Hatyai Hospital in Songkhla, Thailand. All studied patients were randomized using numbered envelopes (block of four) in OA and SPLA by residents. The primary outcome was overall 30 days postoperative complications. Twelve patients diagnosed as ruptured appendicitis during operation were excluded from the study.

Results: There were no significant differences between age, gender, body mass index, preoperative leukocyte count, pathological report and percentage of neutrophil. The overall 30-day complication was similar in both groups. The mean operative time for SPLA group was 37.9 minutes compared with 44.4 minutes for OA group (p = 0.005). Numeric Rating Scale of pain score (NRS) at 4th hour in SPLA group was less than OA group significantly (p = 0.015), while NRS at 8, 12 and 24 hours postoperative were not different between both groups. SPLA shows less pain than OA at 4 hours due to less tissue damage but no difference later. There was no significant difference in length of hospital stay, morphine consumption and time to regular diet in both groups. Most of the patients preferred wound from SPLA than wound from OA.

Conclusion: The single port laparoscopic appendectomy shorter operative time and less pain with similar postoperative complication compared with open appendectomy. From this study, single port laparoscopic appendectomy is safe procedure for treatment acute appendicitis

Keywords: Single port laparoscopic appendectomy, Open appendectomy, Acute appendicitis

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Acute appendicitis is one of the most common causes of surgical abdominal emergency. The standard of treatment has remained appendectomy. In1983, Semm introduced 3 ports laparoscopic appendectomy for treatment of acute appendicitis[1]. Since then, it has been accepted among surgeons for treatment of acute appendicitis because of advantages, such as less postoperative pain, faster postoperative rehabilitation, a shorter hospital stay, and fewer postoperative complications than open appendectomy[2-6]. Single port laparoscopic appendectomy [SPLA] was introduced to perform in acute appendicitis in1998[7]. This procedure was performed through incision at umbilicus. It was acknowledged as having the advantage of improving cosmetic wound. Recently meta-analysis, similar postoperative morbidity and wound infection rates for SPLA and conventional laparoscopic appendectomy [8-17]. But there are few studies evaluating comparing surgical outcomes of SPLA and Open appendectomy [OA][10]. The primary outcome is to compare complication after SPLA with OA in the patient diagnosed as acute appendicitis.

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Materials and Methods

Sample size was determined complication between laparoscopic and open appendectomy based on S. Olmistudy [18]. The present study was conducted at Hatyai hospital in Songkhla, Thailand.The study was registered on clinicaltrial.in.th with number TCTR 20160712004 and approved from IRB of Hatyai Hospital, Songkhla. 172 patients with diagnosis of acute appendicitis were enrolled in the present study from October 2015 to February 2017. A written informed consent was obtained from all patients before

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randomization. Patients were excluded if the diagnosis of appendicitis was not clinically established. The patients with following conditions were also excluded: age less than 14 years old, pregnancy, perforated appendicitis, appendiceal mass, "Full term of ASA" [ASA] III-V, contraindication to general anesthesia.

All of patients were randomized using numbered in closed envelopes (block of four) into SPLA or OA groups by residents. Patients were randomized when surgeon and laparoscopic equipment were available. Patients were not consecutive because laparoscopic service was not done 24 hours.

The patients received an intravenous injection of metronidazole 500 mg and ceftriaxone 2 gm before incision 30 minutes. All patients were instructed to void prior to operation, no urinary bladder catheterization.

Open appendectomy was performed through a McBurney incision in right lower quadrant by surgical residents. The mesoappendix was divided. The inflamed appendix was ligated with chromic catgut 2-0, then inverted appendicial stump with a purse string suture (chromic catgut 3-0). The fascia was closed using absorbable suture (vicryl 1-0). The skin was closed with non-absorbable suture (nylon 3-0).

SPLA was performed through umbilicus with skin incision length 1.5-2.0 cm was by single surgeon that performed SPLA more than 50 cases. The Glove port (Nelis, Gyeonggi-do, Korea) was introduced through umbilical incision. The operating table was placed in the Trendelenburg position with the right side rotated up. Pneumoperitoneum was created with CO_2; intra abdominal pressure was controlled under 15 mmHg. A rigid zero degree 10-mm laparoscopic camera was introduced to locate the appendix, mesoappendix and rule out other cause. The adhesiolysis procedure was performed if adhesion was found. The appendix was manipulated by combination of two 5 mm laparoscopic graspers. LigaSure™ 5mm blunt tip (Covidien, Mansfield, Massachusetts, USA) was applied to divide mesoappendix. The 3 silk endoloops (Hatyai silk loop, Figure 1) were applied at base of appendix then the appendix was transected with LigaSure™ between silk loops. The appendiceal stump was removed together with Glove port to protect contamination of abdominal wall. We did not use endobag. Fascia was closed with absorbable suture, interrupted suture. Skin was closed with 4-0 absorbable, subcuticular suture. Small gauze was packed over umbilical wound to restore the natural umbilicus (Figure 2).

Figure 1. Hatyai silk loop.

Figure 2. Patients umbilical wound.

Postoperative, all patients were routinely recorded pain score [NRS] at 4, 8, 12 and 24 hours postoperative. Morphine 3 milligrams was given to patient if NRS more than 5 or patient's required. They were started diet if they had bowel sound more than 3 times per minute and no fever. All patients were discharged when they tolerated a regular diet, no fever for 24 hours and no abdominal pain. All of patients were follow up visit at 1 week and 30 days after discharge. They were evaluated by the same surgeon for assessment of surgical wound, presence of fever, tolerance of food intake and wound satisfaction.

Ethics Consideration

The authors' research was designed as a prospective randomized trial and approved by Hatyai ethics committee.

Statistical Methods

The parameters obtained were summarized in computerized spreadsheet and statistical analysis was performed by using STATA MP-13(StataCorp LLC, Texas, USA). The two groups were compared using Student's t test for continuous variables. Categorical variables were analyzes by Chi square test or Fisher's exact test. Numerical data were presented as mean ± SD and categorical data were expressed as number and percent. Statistical significance was defined as

p-value ≤ 0.05.

Results

The present study enrolled 172 patients treated for acute appendicitis in the Surgery Department at Hatyai Hospital in Thailand. Twelve patients diagnosed as ruptured appendicitis during operation were excluded from study.160patients including 86 patients (53%) male and (46.2%) female with mean±SD of age is 32.8±13.6 years in SPLA group and 32.9±13.6 years in OA group. All patients were ASA 1-2. There was no difference in age, gender, body mass index(BMI), preoperative white blood cell count(WBC) and percentage of neutrophil between both groups (Table1).

There is no conversion to open technique and no using addition port in SILA group. The drain was not inserted both groups. The mean operative time was significantly shorter in SILA group (37.9±9.2 minutes) than OA group (44.4±17.9 minutes) ($p = 0.005$).

The postoperative pain at 4th hours in SILA group was significantly lower when compared with OA group but the postoperative pain at 8, 12 and 24 hours were not significantly different between 2 groups (Table2). The morphine consumption, length of hospital stay, time to regular diet was similar in both groups.

The overall complications within 30 days were not significant difference between the 2 groups ($p = 0.443$). Overall 30-day complications occurred only 7 cases (3.75%), and did not require readmissions. Two patients in SPLA group and three patients in OA group had superficial surgical site infection. These patients were treated with oral antibiotic. Two patients had abdominal wall abscess in OA group, treated with oral antibiotic and drainage pus from surgical wound. The intra-abdominal abscess was not found in the present study.

The pathological reports were similar in both groups (Table 2). 55 patients (96.88%) favored wound from single port laparoscopic appendectomy via umbilicus. But 5 patients (3.12%) in OA group favored their wound.

Table1. Demographic Data of randomized patients

Demographic data	SPLA (n = 80)	OA (n = 80)	*p*-value
Age (years)	32.8±13.6	32.9±13.6	0.931
Male/Female	38/42	48/32	0.113
BMI (kg/m^2)	22.6±3.6	22.7±3.8	0.944

SPLA single port laparoscopic appendectomy; OA open appendectomy; BMI body mass index

Table 2. Postoperative outcomes

Outcomes	SPLA (n = 80)	OA (n = 80)	p-value
Operative time (minutes)	37.9±9.2	44.4±17.9	0.005*
NRS 4 hours	5.18±3.1	6.29±2.8	0.018*
NRS 8 hours	4.2±3.2	4.7±3.3	0.331
NRS 12 hours	4.08±8.4	4.12±3.1	0.960
NRS24 hours	2.7±2.4	3.2±2.7	0.153
Morphine consumption (mg)	6.24±4.4	7.34±4.9	0.137
Time to regular diet (day)	2.7±0.7	2.8±0.6	0.202
Hospital stay (day)	2.92±0.84	2.98±0.81	0.702
Overall 30-day Complications	2 (2.5%)	5 (6.25%)	0.443
Pathological finding			
Acute appendicitis	58	57	
Complicated appendicitis	22	23	

SPLA single port laparoscopic appendectomy; OA open appendectomy; NRS numeric rating scale; * Statistical significant is *p*-value<0.05

Discussion

Several studies have demonstrated that laparoscopic appendectomy resulted in an excellent exploration of the abdominal cavity, less pain, decrease hospital stay, early return to normal activity, less complication and better cosmetic wound[11,12], shorter operating time but it had, higher cost and need more experience of the surgeon. With the advanced of laparoscopic technique and equipment, the SPLA procedure was introduced in treatment acute appendicitis with attempt to decrease length of incision, less postoperative pain, rapid recovery and less scar. Several studies used various multiport devices or multiple conventional ports through a single umbilical incision. But there was no study to compare effect of different port device in patients with acute appendicitis to postoperative outcome.

Wound complication occurred in SPLA 2.5% and OA 6.25% but they were not significant difference. In the author's my opinion, open appendectomy was prone to more wound infection because more skin edge contamination from inflamed or ruptured appendix. In SPLA, appendiceal specimen was removed into Globe port (Nelis, Gyeonggi-do, Korea) to prevent contamination of wound edge. Intra-abdominal abscess was not found in both groups. This complication may be related to rupture appendicitis or spillage of fecal content during the removal of appendiceal stump, but they were none in the present study. There was no other wound complication such as bleeding or wound dehiscence.

Several meta-analysis studies showed operative time in single port laparoscopic appendectomy longer than the conventional laparoscopic appendectomy[12]. The effect of learning curve of SPLA is indeed important for longer operation time than open and conventional

laparoscopic surgery. Because of single port through umbilicus is parallel and close lie of equipment through single port, lack of triangulation between right and left hand equipment, small space to manipulate equipment and need more learning experience of surgeon on this technique. The present study, mean operative time in SPLA (37.9±9.2) was significantly shorter than OA group (44.4±17.9), whereas ranged of mean operative time in other study was from 35 to 75 minutes for SPLA[10-17]. Our surgeon had experienced in single port appendectomy more than 50 cases prior to the study. There was no using special equipment such as articulated or curved instruments or using additional port in the present study. The author believed that decreasing mean operative time depended on increased experience and using special instrument for difficult condition such as retrocecal appendix type or severe adhesion of inflamed appendicitis.

Most of patients (96.88%) favored SPLA wound than OA wound because they liked minimal scar on their abdomen. But a few patients (3.12%) favor wound form open technique. The standard in wounds satisfaction in everyone was not the same. There were no standard tool to assess wound, and patient's wound satisfaction these were limitation of wound evaluation.

The pain in open and laparoscopic appendectomy related to the injury of muscles and parietal peritoneum. Conventional laparoscopic appendectomy and single port laparoscopic appendectomy cause less postoperative pain when compared with open appendectomy[10]. This result may be due to reduce length of incision and not injury to muscle. In open appendectomy, length of incision depends on thickness of abdominal wall and the difficulty to mobilize appendix. If patients had more abdominal wall thickness, length of surgical wound is too long. But, single port laparoscopic approach uses same length of incision. Thus, pain of single port laparoscopic procedure is less than open procedure in obese patients. This result was supported by postoperative pain (NRS) in SILA group was less than OA group significant, lower morphine consumption in SPLA group (not significant). The SPLA causes less pain at 4 hours postoperative significantly when compared with OA group.

Conclusion

The single post laparoscopic appendectomy is safe procedure for patient with acute appendicitis. Therefore, choice of treatment depends on patient decision and experience of surgeon, cost of operation, availability of laparoscopic instrument. Laparoscopic technique operation is depended on experience of surgeon.

What is already known on this topic?

There are many researches to compare open and laparoscopic technique in patients with acute appendicitis. One research studied compare 3 techniquse (open, conventional 3 port laparoscopic and single port laparoscopic) in treatment of acute appendicitis. But there is no research to direct compare between open and single post laparoscopic technique.

What this study adds?

This study shows the single port laparoscopic appendectomy shorter operative time and less pain with similar postoperative complication compared with open appendectomy.

Disclosure statement

No competing financial interests exist.

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Potential conflicts of interest

The authors declare no conflict of interest.

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