A Technique of Single-Incision Laparoscopic Appendectomy Using Conventional Multiport Laparoscopic Instruments (SILACI): Preliminary Experience of 32 Cases

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Abstract Single-incision laparoscopic appendectomy seeks to further reduce the trauma of parietal access to abdomen. The challenge of this surgery lies in the compromised ergonomics of instrument movement and triangulation. In this context, a feasibility study of an operative technique of single-incision laparoscopic appendectomy with technical modifications was conducted. This prospective study was carried out in tertiary care teaching institute of a semi-urban area in South India over a period of 1 year from June 2010 to May 2011. Thirty-two patients of acute appendicitis were included in this study. Mean operative time was 56.7 min (40–85 min). Mean age of subjects was 41 ± 15 years. M/F ratio was 2:1. There was no significant peri-operative morbidity or mortality. Mean follow-up period was 8 months. We propose that this technique of single-incision laparoscopic appendectomy using conventional multiport laparoscopic instruments (SILACI) is feasible, safe, and cost-effective.

Keywords Appendectomy · Single-Incision Laparoscopic Surgery (SILS) · Ergonomics · Multiport Appendectomy

Introduction

Appendectomy is one of the frequently performed procedures in general surgery [1]. It can be performed by various techniques like open surgical, laparoscopic assisted, total laparoscopic multiport, single-incision laparoscopic (SILS) and natural orifice transluminal endoscopic (NOTES) appendectomy [2–6]. Open and multiport laparoscopic techniques are time tested and already established modalities. SILS appendectomy is a further step towards lesser invasive surgical procedure and could become an alternative to multiport laparoscopic appendectomy. But, it requires certain modified instruments like SILS port, curved instruments, and expertise, which ultimately increases the cost of the procedure, especially in developing countries. The objective of this study is to evaluate the feasibility and safety of our own technique of SILS appendectomy using conventional multiport laparoscopic instruments.

Material and Methods

This prospective study was carried out in the General Surgery department of a tertiary care teaching institute in South India over a period of 1 year from June 2010 to May 2011. We operated 220 cases of laparoscopic appendectomy using conventional multiport technique. In the present study, 32 patients of acute appendicitis treated with SILS appendectomy were included. All of them were operated as an emergency procedure. Elective appendectomies were an exclusion criterion in this study. All the surgeries were performed using conventional multiport laparoscopic instruments. Patients were selected according to the following criteria.

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Inclusion criteria:

- Age=12–60 years
- Clinically and/or sonographically proven acute appendicitis
- No co-morbid conditions (ASA grades I and II) [7]

Exclusion criteria:

- Elective appendectomies
- Pregnancy
- Morbid obesity
- Multiple previous abdominal surgeries
- Uncontrolled medical conditions

Instrumentation:

- Endovision: single-chip camera, halogen light source, CO₂ insufflator
- 10-mm 30 ° telescope
- 5-mm 0 ° telescope
- 10-mm trocar—1
- 5-mm trocars —2
- Atraumatic grasping forceps
- Babcock's forceps
- Bipolar diathermy forceps
- Scissors

Procedure

Patient was positioned supine on the operating table with left arm tucked in, head end down (Trendelenburg's position) and right side up. The placement of surgical team and video cart are similar to multiport technique, except for the sitting position of the camera assistant besides the operating surgeon. Under general inhalational anesthesia, a 2.5-cm single, curved, supra-umbilical incision was given. Pneumoperitoneum was created by open technique using blunt 10-mm trocar. Abdominal cavity was explored with 10-mm 30 ° telescope. After confirmation of the diagnosis, the position of appendix was identified. Two 5-mm trocars were placed by the side of the first trocar, one right infero-lateral and one right supero-lateral (Mickey Mouse configuration) (Fig. 1).

Appendix was grasped with Babcock's forceps and mesoappendix was cauterized and incised with bipolar forceps. Appendix was dissected up to the base. Base was doubly ligated on the cecal side and singly ligated on specimen side with the endoloop and resected in between (Fig. 2). The 10-mm telescope was replaced by 5-mm 0 ° telescope. Specimen was removed through the 10-mm port. The 10-mm port site was sutured with non-absorbable suture. Skin was sutured with silk. We

Fig. 1 Supra-umbilical port placement with Mickey Mouse configuration (Arrow)

suggest an acronym—SILACI (single-incision laparoscopic appendectomy with conventional multiport instruments) for this procedure.

The clinical, operative, and outcome data of all the cases were documented and analyzed systematically.

Results

In the present study, 32 patients underwent SILACI. F/M ratio was 1:2. Mean age of patients was 41 ± 15 ; 23/32 (72 %) of cases presented with a classical picture of acute appendicitis meeting modified Alvarado score of

Fig. 2 Intra-operative view showing inflamed appendix (white arrow) and division of appendicular base between endoloops (black arrow)

≥ 7 [8]. The remaining nine cases had clinical features highly suggestive of appendicitis but with modified Alvarado score of <7 . The operative time was calculated from insertion of first trocar to the port closure. Operative details including related morbidity are detailed in Table 1.

The mean duration of operation for 27 patients, who had successful SILACI was 56.7 min (40–85). Five patients required additional hypogastric port for various reasons. Among them, two patients had difficult meso-appendiceal dissection (due to bleeding), serosal tear of cecum in one and difficult retrocecal appendicitis in two patients.

There was no significant post-operative morbidity requiring re-exploration. All the patients were encouraged for early ambulation and returned to normal activity and diet within 2 days (1–4). Majority of the patients (87.5 %) were discharged by the second post-operative day. Two patients with post-operative vomiting were discharged on the third post-operative day. One patient had paralytic ileus and was discharged on the fourth day. One patient in whom there was cecal serosal tear with post-operative paralytic ileus was discharged on the fifth post-operative day. In this study, there was no mortality. All the excised specimen were histopathologically confirmed and suggestive of acute appendiceal inflammation. There were no unusual

findings like ectopic gastric mucosa, carcinoids, or worms.

Discussion

Appendicitis is one of the commonest abdominal emergencies in surgical practice and occurs in up to 7 % of the general population [9]. Surgical removal is the treatment of choice. Though it can be performed by various novel surgical approaches and routes, open and multiport laparoscopic appendectomy are established modalities of treatment. The first laparoscopic appendectomy was performed by Kurt Semm of Switzerland in 1980 [10]. However, the procedure was not popularized until the introduction of laparoscopic cholecystectomy in 1985 [10–12]. Conventional open appendectomy was done through classical McBurney's incision or right paramedian incision for centuries [13]. Single-port laparoscopy is not a new technique in its true sense. The gynecologists were doing tubal ligation with a single-puncture laparoscope since the late 1970s. These early instruments had offset eyepieces with a straight operating channel, through which an applicator for the silicon ring occlusion of fallopian tubes could be passed [14]. Appendectomies have been done with a single puncture as early as in 1992 [15]. In this technique, the appendix is coaxed out of the umbilicus to complete the task after cecal mobilization [16]. But, it did not gain popularity over the multiport technique. Laparoscopic multiport appendectomy is a well-accepted procedure and is practiced now-a-days as a minimal invasive procedure for acute appendicitis. SILS and NOTES are yet to be accepted in the routine practice. SILS appendectomy is a step towards less invasive surgical procedure and could become an alternative to multiport laparoscopic appendectomy. But it requires certain modified instruments like SILS port, long telescope or telescope with co-axial light cable, rotic instruments, and expertise, which ultimately increases the cost of the procedure [17].

In the present study, 32 laparoscopic appendectomies were done through single supra-umbilical incision. The procedure was performed with the conventional laparoscopic instruments, which are used for multiport technique. Instead of using an expensive commercial SILS port, we employed an open access technique using routine laparoscopic trocars with Mickey Mouse configuration [18]. Unlike in multiport technique, placement of second and third trocars was more difficult as the close proximity of trocars precluded intraperitoneal visualization of port entry. The trocar placement demands utmost care and expertise to prevent injury to intra-

Table 1 Peri-operative details

Events	Number of cases	Percentage (%)
Intra-operative complications		
• Bleeding	2	6.25
• Gut injury	1	3.13
Operative time		
• 30 min–1 h	23	71.88
• 1 h–90 min	7	21.88
• 90 min–2 h	2	6.25
Conversion to		
• Multiport	5	15.63
• Open	0	
Hospital stay (in days)		
• 2	28	87.5
• 3	2	6.25
• 4	1	3.13
• 5	1	3.13
Post-operative morbidity		
• Paralytic ileus	2	6.25
• Vomiting	2	6.25
• Bleeding	–	–
• Intestinal obstruction	–	–

Fig. 3 Operating team with sitting position of camera assistant (arrow)

abdominal viscera [19–21]. For better ergonomics, the ideal length of telescope should be longer than the hand instruments to keep the camera assistant away from the patient and thus prevent clashing of non-co-axial light cable with the instruments. In the present study, this drawback, due to conventional instruments, was overcome by modifying the camera assistant's position from standing to sitting and keeping shorter intra-abdominal length of telescopic trocar than the instrument trocars (Fig. 3). With this modification, the assistant's hand moves to a different plane, which minimizes the instrument clashing. A similar technique on 17 patients using conventional laparoscopic instruments was reported by Bhatia et al. wherein they employed an additional needlescope for fixation of appendix during dissection and endobag for specimen retrieval [22].

Swording of instrument handles was another difficulty found during procedure due to straight conventional instruments than curved instruments made for SILS [23]. This difficulty was overcome by rotating the handles of hand instruments through 180° and using reverse pistol grip of working instruments (Fig. 4). Lack of triangulation resulted in “sword fighting” of the instruments or the “chopsticks” effect [23]. This was overcome by the surgeon deliberately restricting the movements to small arcs. As the appendix is a mobile organ, the advantage of its mobility was taken to optimize the instrument movements. Though various methods of specimen retrieval such as endobag retrieval [24] and Fisherman technique [25] are described, we used a simple method of retrieving it through a camera port. In our study, retrieval of appendix under vision was difficult as both working ports were 5-mm sized. This was overcome by

Fig. 4 Intra-operative external view—reverse pistol grip of instruments (arrows)

using 5-mm telescope and appendix was removed through 10-mm trocar.

In this study, all the cases performed were emergency appendectomies. There was no significant procedure related to morbidity or mortality. The operative time was more during earlier cases, particularly in patients with retrocecal appendix. But with experience, the operative time could be reduced to that required for multiport technique. Post-operative pain, vomiting, and paralytic ileus were very minimal. Most of the patients were discharged on the second post-operative day. Operative scar was single with better cosmesis as compared to multiport and open techniques. Port site herniation was one of the possible complications, which was fortunately not encountered in our series at average follow-up period of 8 months.

Single-incision laparoscopy procedure in comparison with multiport appendectomy has not shown any statistically significant benefit in terms of operative time, post-operative recovery, or pain in most of the studies [26, 27]. Most of the patients were convinced with cosmesis, but without formal analysis or randomization, it is difficult to claim its cosmetic superiority to multiport appendectomy. Thus, SILACI forms a hybrid technique of SILS and conventional multiport laparoscopic appendectomy. This new technique of SILACI offers an effective alternative approach for emergency appendectomy in any setup having laparoscopic expertise.

Conclusion

We propose that this technique of SILACI is feasible, safe, and cost-effective even in resource-limited setups.

Disclaimer/Conflicts of Interest There are no potential conflicts of interest among the authors regarding the content and work related to this article

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