OUTCOME OF SINGLE-INCISION LAPAROSCOPIC APPENDECTOMY VERSUS CONVENTIONAL THREE-PORT LAPAROSCOPIC APPENDECTOMY- AN OBSERVATIONAL STUDY

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Abstract-
Purpose: Concerns have surfaced as to whether single-incision laparoscopy provides reproducible or improved patient outcomes compared with standard laparoscopy. Through this study we want to analyse the safety and feasibility of the less invasive laparoscopic procedure and compare the results.
Methods: An observational review comparing single-incision laparoscopic (SILS) appendectomy and conventional three-port (multiport) laparoscopic (MP) appendectomy based on different variables.
Results: Based on the duration of surgery, conversion rate, intraoperative blood loss, postoperative transfusion, any intraoperative or postoperative complications, postoperative pain, and length of stay, the results compare the prospects of SILS and MP appendectomy.
Conclusion: SILS appendectomy can be executed as a safe and practical replacement to standard MP appendectomy, with perks including shorter hospital stays, earlier return to work, reduced post-operative pain, and lower complication rates comparable to those of the standardized procedure.

***Keywords*- Appendectomy, Laparoscopic Surgery, Single Incision Laparoscopic Surgery, Appendicitis.**

COVER LETTER
Single Incision and NOTES are recent advances in laparoscopic surgery which has come up in great way and have covered various domains in laparoscopic surgery. Since laparoscopic appendectomy is most common laparoscopic surgery done in institute and hospitals, patient can benefit with advantages of Single incision multiport surgery.
We want to demonstrate technique which is slightly different from conventional SILS which uses costly SILS port and instruments. We use single incision and conventional laparoscopic port and want to compare our results with conventional multiport appendectomy.
This comparative study will help to adapt single incision surgery while using conventional laparoscopic port and instruments and reduce cost of SILS appendectomy.

INTRODUCTION:
The revolution in minimally invasive surgery (MIS) has impacted every aspect of today's society, with several of these procedures becoming gold standard over their open counterparts. The advantages it gives are clear in form of reduced pain, better cosmesis, shorter hospital stay, greater visualisation, and early return to work. The ultra-major operations like pancreatoduodenectomy and major hepatic resections too are being performed via MIS approach with acceptable morbidity, mortality, and other outcomes [1,2]. The natural evolution in this area is focused towards (a) developing better instrumentation which are ergonomically useful reducing surgeon's stress as well as safer towards patients, (b) smaller instruments are being developed to reduce port size, (c) use of single incision for placement of instruments.
The most prevalent approaches currently representing scar less surgery are trans umbilical Single incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES). Although the latter is still battling with some technical and equipment issues, SILS promises to be better prepared for wider usage in surgical community. This novel technique or approach may be placed between NOTES surgery and conventional laparoscopic surgery [1]. With a lifetime prevalence of roughly 8%, acute appendicitis is one of the most frequent clinical presentations requiring emergency surgery [3]. First report of single-puncture laparoscopic appendicectomy technique was performed in 1992 and showed the new approach as a safe and effective alternative to the currently used multiple puncture method [4]. The innovative trans-umbilical method seems to reduce the trauma of surgical access with its reduction of post-operative discomfort and patient cosmesis compared to conventional laparoscopic procedure.
However, other important issues must be critically analysed such as time consumed, complications and difficulties to perform this novel technique. Due to these factors, we undertook this study to help implement single incision laparoscopic appendicectomy (SILS-A) and understand its challenges, restrictions, and benefits over traditional multiport appendectomy(MP-A).

AIMS AND OBJECTIVES:

To assess the feasibility, safety and potential benefits of single incision laparoscopic surgery (SILS) and compare the same with conventional multiport laparoscopic surgery (MP) in terms of cosmesis, cost, operative time, postoperative pain, length of hospital stay and complications for common surgeries by a randomized controlled trial in a tertiary care hospital in Udaipur, Rajasthan, India.

MATERIALS AND METHOD:

Study area: This study was conducted at PMCH, Udaipur, which is a tertiary care, teaching hospital, catering large number of patients with general surgical and gastrointestinal disorders.

Study population: All patients of acute uncomplicated appendicitis which were planned to undergo appendectomy.

Study design and study period

This study was open randomized clinical study with stratified randomization where groups were stratified according to disease (i.e., uncomplicated acute appendicitis). In each group, randomization was done by simple randomization by random numbers. Our study was conducted during June 2020 to December 2022.

Sample size: 30 patients (15 in each group)

Inclusion criteria:

1. Patients of both sex and age group 6-75 years.
2. Acute appendicitis diagnosed by:

Subjective criteria

a. Pain in right lower quadrant of the abdomen with or without nausea, vomiting, or loss of appetite.
b. Migratory pain from peri-umbilical region to right lower quadrant.

Objective criteria

a. Right iliac fossa tenderness
b. Total WBC counts more than 12,000/cc
c. USG or CECT Abdomen suggestive of acute appendicitis (lumen size more than 4mm, non-peristaltic elongated tubular structure in right iliac fossa with peri-appendicular fat stranding or collection)

Exclusion critérié : Appendicitis with aassociated complications like perforation, abscess and mass formation.

SURGICAL TECHNIQUE:

1. SILS Appendectomy

Positioning of the patient and surgeon

The surgery is carried out under general anesthesia. The operative room set-up is optimized for SILS (as the operative degree of freedom is limited in this method. The operation room set-up and patient position is similar to that of a conventional laparoscopic appendectomy except for the monitor and scrub nurse position. The operating surgeon and camera person stands to left of the patient with patient in supine and left lateral tilt. The monitor near the patient's rigt side foot end (Figure 1).

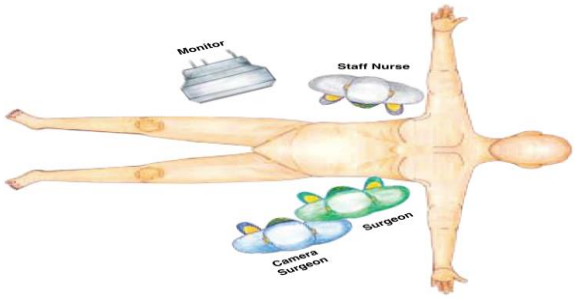


Figure 1: Patient position and team set up

INSTRUMENTATION

SILS trocar, Two 5mm ports, one 7mm port. Veress needle. 30-degree camera [A 50-cm long, 5-mm rigid scope and 90° light adapter (Karl Storz-Endoscope)]. Holder/Grasper. Long-shaft Maryland forceps. Harmonic. bipolar coagulation. Catgut endoloop. Scissors (Figure 2).

Figure 2: Instruments

Surgical procedure

We utilized a single-incision laparoscopic (SILS) appendectomy strategy and use conventional laparoscopic instruments and multiple low-profile trocars (preferably threaded trocars). A light cable that fits onto the laparoscope co-axially and has a low profile is highly desirable to allow for maximal ergonomy. Having a 5 mm angled scopes (30°) provides optimal vision (Figure 3).

Figure 3: Port

Establishing the ports

The umbilicus is infiltrated with 0.25% bupivacaine for pre-emptive anaesthesia prior to the incision. A 15 to 20-mm vertical or curvilinear intra-umbilical incision is made according to the shape of umbilicus for port access to make sure that the scar will be hidden in the umbilicus. We use a Veress needle followed by a closed access method for establishing the pneumoperitoneum. The first port is a 7mm which is inserted in the posterior aspect for camera and the second is 5mm port which is inserted just laterally and above the camera port on the right side for right hand working and the third one is 3mm or 5mm on the left side for left hand working. At the end of the procedure the 7mm port will be converted to 10mm for specimen retrieval depending upon the size of the appendix. During the procedure if any difficulty encountered then 2.8mm needloscope port is used to complete the procedure without compromising the quality.

Localization and exposure of the appendix

Initially, a diagnostic laparoscopy is undertaken. With a Trendelenburg's position and a modest right up tilt of the table the right iliac fossa is explored further. The status of the appendix is ascertained at this stage and a decision is made to either continue with SILS or to convert the procedure to a multi-port laparoscopic appendectomy. Locating the appendix can be sometimes challenging. Usually, however, the appendix can be localized utilizing the same principles as employed in conventional appendectomy. The appendix is grasped with a 5-mm atraumatic grasper.

Control of the mesoappendix

As in laparoscopic appendicectomy, care is taken to avoid avulsion of a friable/gangrenous appendix from its base. The meso-appendix is then targeted. A meso-appendicular window is created and the appendicular artery and its branches are controlled using an ultrasonic shears (Harmonic Scalpel) or a bipolar electrocautery. The base of the appendix is then ligated twice with catgut endo-loops and transected. The terminal ileum is examined by walking the bowel using atraumatic graspers. A Meckel's diverticulum, if identified, may be similarly resected using a SILS approach . A 7-mm trocar can be exchanged at this stage for a 10-mm one to allow delivery of the appendix. Reinsertion of a trocar can be challenging, and needs to be done with care to avoid iatrogenic injuries. An endobag may be used for retrieval of the appendix thus avoiding port-site contamination(Figure 4,5).

Figure 4: Division of appendix

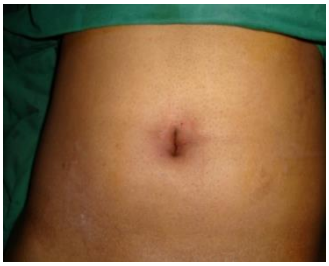
Retrieval of appendix

The ports are then removed under vision and the fascial incision is closed with polypropylene sutures. The wound is infiltrated again with local anaesthetic. The skin incision is closed by 3.0 vicryl in subcuticular fashion and the wound dressed.

Post op follow up:

Post op period, patient kept nil oral for 6 hours and then started on liquid diet, progressed to soft diet next morning, after satisfactory bowel sounds heard. Another dose of prophylactic antibiotic dose given. Analgesia with either paracetamol or tramadol given. And if post op period is uneventful, discharged from the hospital (Figure 6).

Figure 6: Post SILS-A wound



Conventional Lap Appendectomy

Patient Position

The patient is in supine position, arms tucked at the side and 15-20 degree left lateral tilt (right-up). The surgeon stands on the left side of the patient with the camera holder-assistant. For maintaining coaxial alignment surgeon should stand near left shoulder and monitor should be placed near right hip facing towards surgeon(Figure 7).

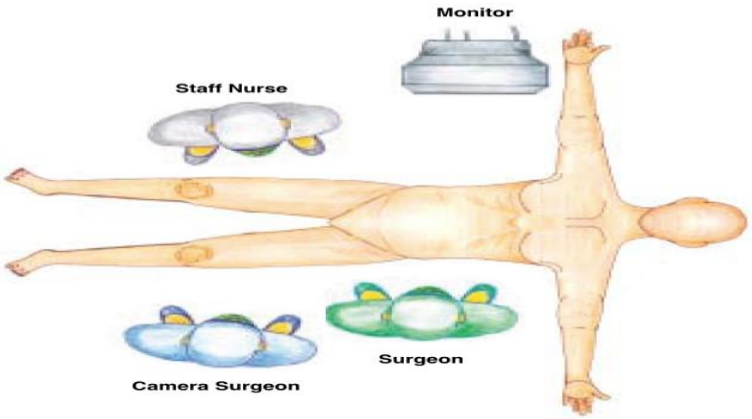


Figure 7: Position

Instruments and Port Position

• Total 3 trocar should be used: One 5 mm- suprapubic area for camera & 7mm- umbilical port for right working hand, One 5 mm right lower quadrant trocar for left working hand.

Veress needle. 30-degree camera [A 50-cm long, 5-mm rigid scope and 90° light adapter (Karl Storz-Endoscope)]. Holder/Grasper. Long-shaft Maryland forceps. Harmonic. bipolar coagulation. Catgut endoloop. Scissors (Figure 8,9)

Figure 8: Instrumentation

Figure 9: Port Position

Technique

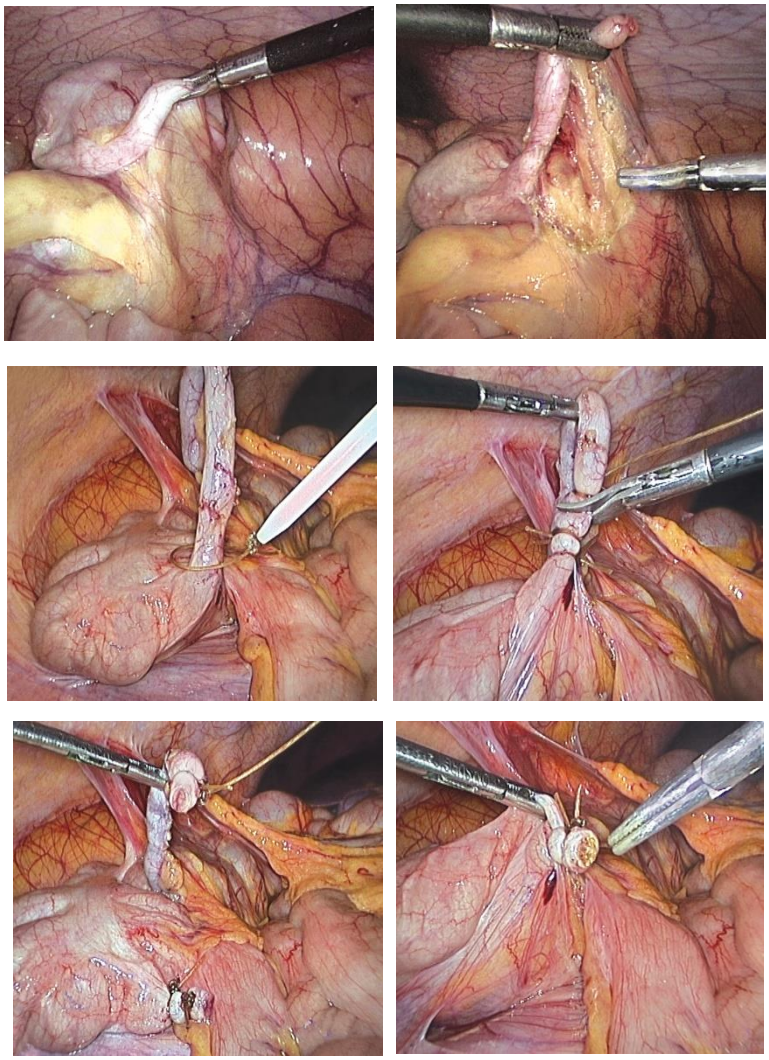
Exposure of the Appendix. At this point the small bowel is lifted of the pelvis exposing the inflamed appendix. Careful manipulation is essential without directly grasping it to avoid bowel injury. The appendix is grasped with the left hand instrument exposing the mesoappendix. This is adherent to the small bowel mesentery and requires careful sharp dissection with scissors and diathermy.

Isolation of Meso-appendicular Artery: Maryland grasper is introduced and a window is created in the mesentery to isolate the appendicular artery.
Cauterizing and Dividing of the Artery: We use bipolar dithermy/Harmonic to cauterize mesoappendix and divide the rest of mesentry. Application of 2 to 3 Endoloops: An endo-loop is introduced and placed at the base of the appendix. It is critically important to visualise the knot of the endo-loop because if this is outside the field of view it can snag onto other structures. The attached thread is divided with scissors. The two remaining endo-loops are placed and the appendix is divided between the second and third endo-loop leaving two endo-loops on the patient side.

Division of the Appendix
At this point we assess the appendix stump and divided vessel to ensure haemostasis.
Retrieval of the Appendix in an Endobag, an endo-bag is introduced through the periumbilical port and the appendix is retrieved in this. Bowel walk is done to see any other pathology.
The remaining ports is removed under vision. The 5mm port is closed with monocryl. The fascia of the 10mm sites is closed with vicryl. The skin is close with monocryl. Local anaesthetic is injected into the incisions and dressings are applied(Figure 10).

Post op follow up
Post op period, patient kept nil oral for 6 hours and then started on liquid diet, progressed to soft diet next morning, after satisfactory bowel sounds heard. Another dose of prophylactic antibiotic dose given. Analgesia with either paracetamol or tramadol given. And if post op period is uneventful, discharged from the hospital.

Figure 10: Various Steps of Conventional Lap.



RESULTS:

Comparison of demographics in two treatment groups for acute appendicitis.

Demographics	SILS-A group (n=15)	MP-A group (n=15)
Age (Mean, SD)	26.77±10.83	27.42±13.28

Gender (Male:Female)		9:6	8:7
BMI (Mean, SD)		24.28±3.59	24.61±3.66
ASA	I	12	12
	II	3	3
Co-morbid Illness	NIL	10	9
	DM	3	3
	HTN	2	3
Post-op pain (VAS score ± SD)	POD-0	5 ± 1	5.01 ±1.1
	POD-1	2 ±1	2.2 ±1
	POD-7	0 ± 0.61	0 ± 0.7
Cost analysis		22175.4 ± 928	23587.9 ± 1879

DISCUSSION:

Our study showed that there was no significant difference between demographics (i.e., age, sex, BMI, comorbidities, ASA grade) between the two treatment groups.

Duration of surgery

The mean duration of surgery in SILS group was significantly higher when compared to conventional multiport laparoscopy group (MP-A) (42.71±5.75 Vs 24.47±3.49 minutes). On reviewing the literature, meta-analysis showed longer operating times in SILS appendicectomy compared to conventional or open procedures, especially in children where surgical space is less compared to adults [5,6].

Conversion rate

In SILS group 3 (10%) patients were converted to conventional laparoscopy group, however no patient from either of the groups was converted to open surgery. On review of literature, meta-analysis showed that, the conversion rate was 7.48% (40 of 535 patients) and 0.75% (4 of 533 patients) in the SILS-A and MP-A (conventional multiport laparoscopic appendectomy) groups, respectively. The rate was significantly higher in patients who received SILS-A than MP-A [6].

Intra-operative blood loss and peri-operative blood transfusion

In our study, the mean blood loss was very minimal and there was no significant difference in both the groups. Thus, no patients required peri-operative blood transfusion.

Intra-opérative complications

In our study, the most common complication was mesenteric tear (2 out of 30 patients i.e., 6.66%, 1 in each group). There was no significant difference between the two study groups.

Post-operative pain

In post-operative period, mean pain (via Visual Analog Scale-V.A.S) scores were assessed on POD-0, POD-1, POD-7 and we found no significant difference in both the groups. Meta-analysis of (V.A.S) pain scores at 12 h post-surgery showed no significant differences between the two techniques. Meta-analysis of pain scores at 24 h following surgery showed there is no significant difference in pain scores between SILS-A and MP-A [7,8].

Duration of stay

The mean hospital stay was same in both the groups i.e., 1.03 ± 0.18 days which is corroborative with similar studies in literature, having hospital stay of 1-2 days [7].

Post-operative complications

In our study, 1 patient of SIL-A had port site infection which was treated with antibiotics and dressing and 1 patient of MP-A had paralytic ileus post-operatively which was managed conservatively. No other significant postoperative complication in either of the groups and no patient was readmitted. Various similar studies also showed no significant post-operative complication [7,9].

Cost of treatment

The average cost of SILS-A and MP-A was 22175.4 ± 928 INR and 23587.9 ± 1879 INR respectively. Our analysis showed the cost difference was clinically significant however it is important to mention here that we did single incision multiport appendectomy using conventional laparoscopic instruments without using SILS port which itself would have increased the cost by 40000-50000 INR. Review of literature also showed similar results when single incision surgery is done using special port [10].

Cosmesis assessment score

Cosmesis was significantly better at 1 week for SILS-A group as compare to MP group. However, on review of literature, cosmesis was not found to be a significant factor affecting patients at 6 weeks and 6 months. Meta analysis of patient reported cosmesis

scores showed that SILS-A had significantly better cosmetic ratings on both the Body Image Questionnaire (BIQ) and VAS scales [7,9].

CONCLUSION:

The results demonstrated SILS appendectomy as a safe and practical substitute for traditional MP appendectomy that can be performed with benefits being less duration of hospital stay, early return to work, less post-op pain and less complication rates comparable to those of the standardised approach. Although, these procedures require longer operative time which can be overcome by expertise of the Surgeon and practice as we all know that Laproscopic surgeries have a longer learning curve and standardized open procedures. This review serves as a foundation for prospective studies that are necessary to establish with certainty the similarity of operating times, complications, and hospital stays as well as to clarify variations in patient-centred outcomes like postoperative pain, cosmesis, and quality of life.

CONFLICTS OF INTEREST: None

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