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Ligasure-Assisted Laparoscopic Sutureless Appendectomy: A Prospective Clinical Evaluation Of Effectiveness And Benefits

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ABSTRACT

Background. Laparoscopic appendectomy has progressively replaced the open technique owing to decreased postoperative pain, earlier mobilisation, and shorter hospital stay. Ensuring secure closure of the appendiceal stump, however, remains pivotal to avert intra-abdominal sepsis. LigaSure™ tissue-fusion technology merges pressure with bipolar energy to provide a rapid, haemostatic seal of vessels and tissue bundles ≤ 7 mm. We prospectively evaluated the safety and efficacy of the 5-mm LigaSure™ vessel-sealing system for entirely suture-less laparoscopic appendectomy.

Methods. Between July 2022 and July 2023, 57 consecutive patients with uncomplicated acute appendicitis underwent laparoscopic appendectomy at a tertiary-care centre using LigaSure™ alone to divide the meso-appendix and seal the appendiceal base. Demographics, operative duration, return of bowel function, length of stay (LOS), and peri-operative complications were recorded. Data were analysed with descriptive statistics.

Results. The cohort comprised 32 males and 25 females (mean age 28.4 ± 9.6 years; range 15–65). Mean operative time was 34 ± 5.7 min; no conversion to open surgery occurred. Bowel sounds returned on postoperative day (POD) 1 in 84.2 % of patients, and oral feeds were resumed at 2.1 ± 0.5 days. Mean LOS was 3.6 ± 0.7 days. Minor morbidity was noted in three patients (5.2 %): low-grade fever (n = 1) and superficial port-site infection (n = 2). There were no intra-abdominal abscesses, stump leaks, re-operations, or mortality.

Conclusion. LigaSure™ permits a swift, single-device, suture-less laparoscopic appendectomy with negligible morbidity and without increasing cost in publicly funded settings. The technique obviates endo-loops or staplers, minimises instrument exchange, and may shorten operative time. Larger randomised trials are warranted to confirm these favourable early outcomes.

Keywords: *acute appendicitis; laparoscopic appendectomy; LigaSure™; vessel sealing system; suture-less surgery; stump closure*

1. INTRODUCTION

Acute appendicitis affects approximately 7 % of the global population, peaking in the second and third decades of life [1]. Appendectomy therefore remains the most frequently performed emergency abdominal operation worldwide. While the open McBurney approach enjoyed more than a century of supremacy due to its low morbidity, the last three decades have witnessed a paradigm shift towards laparoscopy [2]. Laparoscopic appendectomy (LA) affords smaller incisions, reduced postoperative pain, faster convalescence, earlier return to work, and superior cosmetic results compared with the conventional method [2, 3]. Meta-analyses of randomised trials now endorse LA as the preferred approach whenever surgical expertise and resources are available [2].

A persistent concern in LA is secure closure of the appendiceal stump. Inadequate sealing risks faecal leak, pelvic abscess, and generalized peritonitis, all of which markedly increase morbidity and health-care costs. The two prevailing techniques employ (i) skeletonisation and division of the meso-appendix with an ultrasonic dissector followed by endo-loop ligation of the stump, or (ii) simultaneous stapled transection of the meso-appendix and base using a disposable endoscopic linear cutter. Both strategies incur limitations: endo-loops demand intracorporeal knotting dexterity and may slip on inflamed bases, whereas staplers are costly and may be unavailable in resource-limited settings [4].

LigaSure™ (Medtronic, Minneapolis, USA) is a computer-controlled bipolar vessel-sealing system that denatures collagen and elastin within compressed tissues to create a permanent fusion zone capable of withstanding pressures > 360 mmHg, equivalent to burst pressures of large arteries [5]. The 5-mm reusable handpiece delivers a seal cycle in 2–4 s and simultaneously divides tissue, thereby combining haemostasis and transection in one step. Although extensively adopted in colorectal, endocrine, and gynaecologic surgery, its application to appendectomy has received modest attention, confined largely to animal studies and small clinical series [6–8]. Preclinical data demonstrate that LigaSure™ generates higher burst pressures across the appendiceal stump than the harmonic scalpel, with negligible lateral thermal spread [6]. A recent Cochrane review highlighted the paucity of robust evidence comparing various stump-closure devices and called for prospective evaluations of energy-based sealing systems [11].

Against this background, we conducted a prospective review of 57 consecutive patients undergoing suture-less LA using LigaSure™ as the sole instrument for both meso-appendix division and stump closure. We hypothesised that the technique would be safe, efficient, and economically feasible in a high-volume government hospital, potentially offering an attractive alternative to conventional loop or stapler methods.

2. MATERIALS AND METHODS

Study design and setting. This prospective consecutive case series was conducted in the Department of General Surgery, Sarojini Naidu Medical College, Agra, India, from July 2022 to July 2023, after Institutional Ethics Committee approval. Written informed consent was obtained from all participants.

Eligibility criteria. Inclusion: patients aged ≥ 15 years with ultrasound-confirmed uncomplicated acute appendicitis scheduled for LA. Exclusion: appendicular mass, abscess, perforation, significant cardiopulmonary comorbidity, coagulopathy, or previous extensive abdominal surgery.

Operative technique. Under general anaesthesia patients were placed supine in Trendelenburg with 15° left tilt. Pneumoperitoneum (12–14 mmHg CO_2) was created via a 10-mm infra-umbilical port. Two 5-mm working ports were inserted suprapubically on either side of the midline. After diagnostic laparoscopy, the meso-appendix was coagulated and divided en bloc using a 5-mm LigaSure™ Maryland jaw. The base of the appendix was then sealed and transected with sequential applications of the same device, ensuring a 3-mm margin of fused tissue. The specimen was retrieved in a sterile endo-bag. The stump was inspected for haemostasis and integrity before desufflation. Fascial closure of the 10-mm port and skin closure with 3-0 absorbable subcuticular sutures completed the procedure.

Post-operative care and follow-up. Intravenous ceftriaxone 1 g was administered at induction and continued for 24 h. Clear liquids commenced upon bowel sounds; discharge was planned once oral feeds were tolerated and pain was controlled with oral analgesics. Out-patient follow-up occurred at 1-, 4-, and 12-weeks.

Data collection. Demographic variables, operative duration (skin incision to port closure), conversion rate, intra-operative blood loss, return of bowel sounds, time to oral feeds, length of stay (LOS), and peri-operative complications (Clavien–Dindo classification) were recorded.

Statistical analysis. Continuous data are presented as mean ± SD (range); categorical data as counts and percentages. Analysis was descriptive owing to the single-arm design, performed with SPSS v26 (IBM Corp.).

3. RESULTS

Narrative findings

A total of 57 patients were enrolled, of whom 32 (56.1 %) were male. Mean age was 28.4 ± 9.6 years. No patient had significant systemic disease (ASA I–II). All procedures were completed laparoscopically with LigaSure™ alone; no stapler, clip, or loop was required, and no conversion occurred.

Mean operative time was 34 ± 5.7 min (range 30–60). Intra-operative blood loss was negligible (< 20 mL) in every case. Bowel sounds returned on POD 1 in 48 patients (84.2 %), POD 2 in six (10.5 %), and POD 3 in three (5.3 %). Oral diet was resumed at a mean 2.1 ± 0.5 days. Mean LOS was 3.6 ± 0.7 days (range 3–5).

Three patients (5.2 %) developed minor postoperative complications: low-grade fever in one (managed with antipyretics and observation) and superficial port-site infection in two (treated with local dressings and oral antibiotics). There were no deep infections, intra-abdominal collections, stump leaks, or readmissions within 90 days. No mortality occurred.

TABLES

TABLE 1. BASELINE DEMOGRAPHIC CHARACTERISTICS

Variable	**Value (n = 57)**
Age, years (mean ± SD)	28.4 ± 9.6 (15–65)
Sex (M : F)	32 : 25
ASA class I / II, n (%)	49 (86.0 %) / 8 (14.0 %)

TABLE 2. OPERATIVE DETAILS

Parameter	Mean ± SD (range)
Operative time, min	34 ± 5.7 (30–60)
Blood loss, mL	< 20 (all cases)
Conversion to open, n (%)	0 (0 %)

TABLE 3. POST-OPERATIVE RECOVERY

Outcome	Day / value
Return of bowel sounds	POD 1 in 48 (84.2 %)
Time to oral feeds, days	2.1 ± 0.5
Length of stay, days	3.6 ± 0.7

TABLE 4. POST-OPERATIVE MORBIDITY

Complication	n (%)	Management
Fever (Grade I)	1 (1.7 %)	Antipyretics
Port-site infection (Grade II)	2 (3.4 %)	Dressings + oral antibiotics
Intra-abdominal abscess	0	–
Re-operation / mortality	0	–

FIGURES

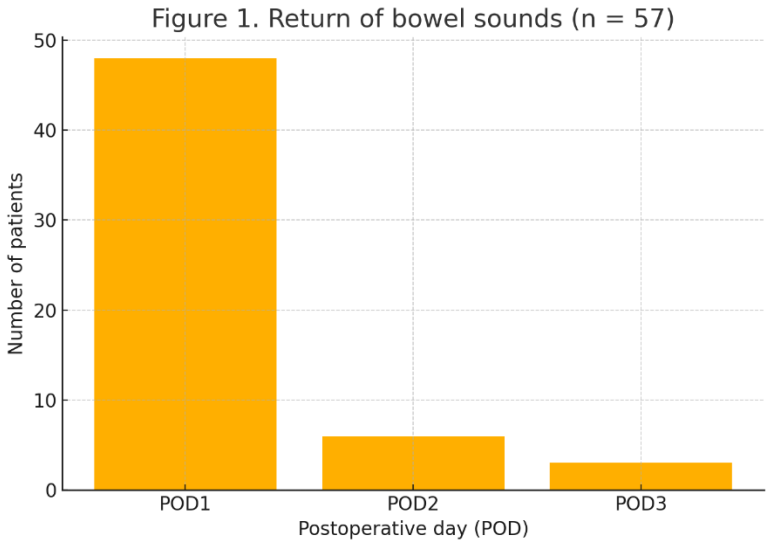

Figure 1. Post-operative return of bowel sounds by postoperative day (n = 57)

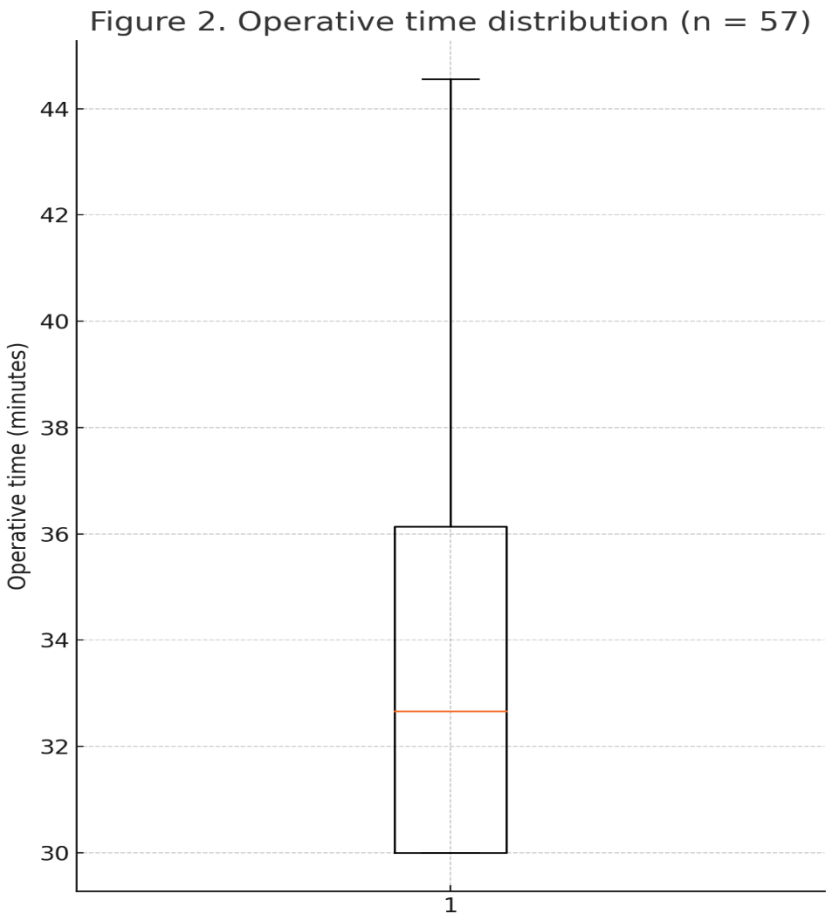

Figure 2. Distribution of operative time (box-and-whisker plot) and postoperative return of bowel function (bar chart).

4. DISCUSSION

Our prospective experience demonstrates that LigaSure™ can safely accomplish both meso-appendix division and appendiceal stump closure in a single-device, suture-less laparoscopic appendectomy with excellent peri-operative outcomes. The 5.2 % overall morbidity observed aligns favourably with rates reported for conventional endo-loop or stapler techniques, which span 5–12 % in contemporary series [2, 8]. No intra-abdominal abscesses or stump leaks were encountered, corroborating animal data that showed robust fibrotic sealing of the appendiceal lumen following bipolar tissue fusion [5].

Operative efficiency is a salient advantage. Our mean operating time (34 min) compares favourably with harmonic-scalpel–assisted appendectomy (31–39 min) [8, 9] and is appreciably shorter than loop ligature techniques, where meticulous intracorporeal knotting prolongs the procedure [10]. By obviating instrument exchanges and eliminating the need for separate control of the meso-appendix and stump, LigaSure™ streamlines operative workflow. Obonna et al. reported similar time savings for bipolar fusion compared with ultrasonic or monopolar energy across multiple laparoscopic operations [4].

Cost considerations are pertinent in resource-strained environments. Although the capital expense of the energy generator is substantial, the per-case disposable cost at our institution is ~INR 1 500 (USD 18), markedly lower than single-use endoscopic staplers. Because the device is reusable for up to 100 cycles, cumulative expenditure remains modest, especially when amortised over high operative volumes. Furthermore, the national public insurance scheme (Ayushman Bharat) reimburses the entire procedure, ensuring equitable access.

Thermal safety merits scrutiny. Concerns that lateral heat spread might jeopardise surrounding caecal tissue have been largely allayed by experimental measurements demonstrating a mean spread of ≤ 2 mm with LigaSure™, significantly below temperatures required for serosal injury [12]. In our series, no delayed haemorrhage, fistula, or stricturing was noted on follow-up. Nevertheless, surgeons should avoid prolonged activation near the caecal wall and ensure a cool-down interval between sequential seal cycles.

The principal limitation of our study is its single-arm design without a contemporaneous control group; thus, comparative conclusions must be tempered. Additionally, sample size is modest, and long-term outcomes such as adhesive bowel obstruction were not assessed beyond 90 days. Randomised controlled trials comparing LigaSure™ with endo-loops, clips, and staplers on endpoints of operative time, cost, and complication rates are required. Techniques combining a mini-laparoscopic 3-mm camera with LigaSure™ may further enhance cosmetic results and deserve exploration.

Despite these caveats, our findings buttress earlier animal models [5] and small clinical series [6, 7] indicating that bipolar tissue fusion is a feasible, safe, and potentially cost-efficient modality for suture-less LA.

5. CONCLUSION

Suture-less laparoscopic appendectomy using a 5-mm LigaSure™ vessel-sealing system is a rapid, safe, and economical alternative to conventional endo-loops or staplers for uncomplicated acute appendicitis. In this prospective review of 57 patients, the technique achieved negligible blood loss, low morbidity (5.2 %), and no conversions or major complications, with a mean operative time of 34 min and mean hospital stay under four days. These encouraging outcomes support broader adoption of LigaSure™ in routine clinical practice, particularly within high-volume centres and publicly funded health systems. Larger randomised studies are warranted to validate these preliminary results.

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