



## A Comparison of Absorbable Polymetric Clips and Metallic Clips in Laparoscopic Appendectomy

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**Background:** Laparoscopic appendectomy is the most common emergent surgery, and various techniques were used for the closure of appendicular stump and appendiceal artery. **Aim:** This study aimed to compare the clinical impacts of absorbable polymeric clips and traditional metallic clips. **Methods:** We reviewed the laparoscopic appendectomies performed from June 2020 to May 2021 in a medical center. We analyzed the characteristics and intraoperative and postoperative data of patients receiving absorbable or metallic clips during laparoscopic appendectomy. **Results:** A total of 120 patients were enrolled in this study. Fifty-nine patients received lapro-clips for the ligation of appendicular stump and artery (Group A), whereas 61 patients received titanium clips (Group B). The operative time for both groups was  $63.6 \pm 18.9$  min and  $65.5 \pm 19.2$  min, respectively ( $P = 0.586$ ). There was no significant difference in postoperative complications ( $P = 0.958$ ). The length of hospital stay for each group was  $3.07 \pm 1.14$  days and  $2.90 \pm 1.18$  days, respectively ( $P = 0.435$ ). **Conclusion:** The application of absorbable polymetric clips is feasible and safe with the additional benefit of leaving no foreign body for the closure of appendicular stump and ligation of appendiceal artery for laparoscopic appendectomy.

**Key words:** Acute appendicitis, appendiceal stump closure, ligation of artery, absorbable clip, metallic clip

### INTRODUCTION

Appendicitis is the most common disease that requires urgent surgical intervention. It is estimated that 300,000 appendectomies were performed annually in the United States.<sup>1</sup> Laparoscopic approach gradually becomes the gold standard method for acute appendicitis.<sup>2</sup> In the past decades, many studies have proven that laparoscopic appendectomy (LA) is safer and more feasible compared to the traditional open surgery.<sup>3-5</sup> LA reduces the surgical time, hospital stay, postoperative pain, and complication rates. Various techniques were used and investigated for the closure of the appendicular stumps because this is the most crucial step in LAs.<sup>6-9</sup> Absorbable polymetric clips were invented and used in various surgical fields in the past few years. Using polymetric clips for the closure of appendicular stump and ligation of appendiceal artery is a relatively new technique. Hence, a single-center,

retrospective study was performed to evaluate the feasibility and safety of using absorbable clips for LA.

### MATERIALS AND METHODS

#### Study design

This study was approved by the Ethics Committee (TSGHIRB No.: B202105118). Patients diagnosed with acute appendicitis were enrolled. Interval appendectomy, pelvic inflammatory disease-related appendicitis, and appendiceal neoplasm were excluded in this study. The patients were divided into two groups. Group A received 12-mm absorbable polymetric clips (Lapro-Clip™, Medtronic, Minneapolis, Minnesota, US) for appendicular stump and 8-mm ones for appendiceal artery. Group B received titanium clips (Endo Clip™, Medtronic,

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Minneapolis, Minnesota, US). The primary outcome measures were operative time, intraoperative complications, postoperative complications, pathological diagnosis, and hospital stay length. Intraoperative complications were defined as injury to adjacent organs and severe bleeding. Postoperative complications included surgical site infections, postoperative bleeding that requires a second operation, and postoperative ileus that requires prolonged hospital stay, conservative treatment, and intra-abdominal abscess formation. All complications were further categorized using the Clavien–Dindo classification. The final pathology diagnosis was divided into three subgroups: acute appendicitis, acute suppurative appendicitis, and acute gangrenous appendicitis. All clinical data were collected from a physician who did not participate in the surgery or care of the patients.

### Statistical analysis

Statistical analyses were performed using the SPSS version 22.0 software (IBM, Armonk, NY, USA) by a statistical expert who was not in contact with the patients. The variables between the two groups were compared using unpaired *t*-test, Fisher's exact test, and Mann–Whitney *U* test. Continuous variables are presented as mean  $\pm$  standard deviation. A two-tailed *P* < 0.05 was considered statistically significant.

## RESULTS

A total of 120 LAs were performed. Fifty-nine patients received absorbable clips (Group A), whereas 61 patients received metallic clips (Group B). The patient's characteristics were similar with regard to their age, gender, body mass index, and the American Society of Anesthesiologists classification [Table 1]. The severity of the disease was accessed by the initial laboratory data of white blood count (WBC) and C-reactive protein (CRP). The mean WBC was  $12.53 \pm 4.15 \times 10^3/\mu\text{L}$  for Group A and  $12.43 \pm 3.90 \times 10^3/\mu\text{L}$  for Group B (*P* = 0.886). The CRP level in Group A was  $2.67 \pm 4.41$  mg/dL, whereas that in Group B was  $3.68 \pm 6.12$  mg/dL (*P* = 0.311). Both data showed no significant difference in patient selections.

The operative time for both groups was similar ( $63.6 \pm 18.9$  min and  $65.5 \pm 19.2$  min, respectively; *P* = 0.586). None of the patients had severe intraoperative complications. However, three patients from Group A and four patients from Group B had postoperative complications. Two patients developed intra-abdominal abscesses that required prolonged drainage and longer hospital stay. One patient from Group A and two patients from Group B developed postoperative ileus and required prolonged fasting and

Table 1: Clinical features of patients undergoing laparoscopic appendectomy (Group A: Lapro-clip; Group B: Titanium clip)

| Characteristics                   | Group A (n=59)   | Group B (n=61)   | <i>P</i> |
|-----------------------------------|------------------|------------------|----------|
| Age (years)                       | 43.4 $\pm$ 14.3  | 41.5 $\pm$ 15.9  | 0.487    |
| Gender (male/female)              | 30/29            | 29/32            | 0.855    |
| Height (cm)                       | 166.5 $\pm$ 8.4  | 165.6 $\pm$ 7.8  | 0.553    |
| Weight (kg)                       | 65.7 $\pm$ 12.9  | 64.4 $\pm$ 15.1  | 0.628    |
| BMI (kg/m <sup>2</sup> )          | 23.6 $\pm$ 3.5   | 23.3 $\pm$ 4.2   | 0.719    |
| Diabetes (+)                      | 4 (6.8)          | 3 (4.9)          | 0.715    |
| ASA classification (%)            |                  |                  |          |
| Class I                           | 36 (61.0)        | 34 (55.7)        | 0.836    |
| Class II                          | 22 (37.3)        | 26 (42.6)        |          |
| Class III                         | 1 (1.7)          | 1 (1.6)          |          |
| Body temperature (°C)             | 37.5 $\pm$ 0.6   | 37.5 $\pm$ 0.5   | 0.740    |
| WBC ( $\times 10^3/\mu\text{L}$ ) | 12.53 $\pm$ 4.15 | 12.43 $\pm$ 3.90 | 0.886    |
| CRP (mg/dL)                       | 2.67 $\pm$ 4.41  | 3.68 $\pm$ 6.12  | 0.311    |

Data are presented as mean $\pm$ SD or as the number. BMI=Body mass index; WBC=White blood count; CRP=C-reactive protein; ASA=American Society of Anesthesiology; SD=Standard deviation

parenteral nutrition. One patient from each group developed surgical site infection and required further wound care during outpatient follow-up. None of these patients were rehospitalized for severe postoperative adverse effects. The overall postoperative complication rates were not significantly different (*P* = 0.958). The final pathology results discovered 62 acute appendicitis (34 in Group A vs. 28 in Group B), 47 acute suppurative appendicitis (19 in Group A vs. 28 in Group B), and 11 acute gangrenous appendicitis (six in Group A vs. five in Group B) (*P* = 0.307). It revealed that the severity in each group was comparable. The length of hospital stay for each group was  $3.07 \pm 1.14$  days and  $2.90 \pm 1.18$  days, respectively (*P* = 0.435), which demonstrated no significant difference. The perioperative and postoperative data are shown in Table 2.

## DISCUSSION

The closure of appendicular stump and ligation of appendiceal artery are the most important steps in LAs. Various techniques for mesoappendix dissection and appendiceal artery ligation were purposed. These include endoclip, electrocautery, Harmonic scalpel, and LigaSure energy device.<sup>10</sup> Harmonic scalpel and LigaSure energy devices ensure vessel sealing when used for vessels under 7 mm in diameter.<sup>11,12</sup> It is fast and feasible in the dissection of mesoappendix; however, the expenses needed to use energy devices for a relatively simple surgical procedure are not

Table 2: Intraoperative and postoperative data of undergoing laparoscopic appendectomy (Group A: Lapro-clip; Group B: Titanium clip)

| Characteristics                             | Group A (n=59) | Group B (n=61) | P     |
|---------------------------------------------|----------------|----------------|-------|
| Operative time (min)                        | 63.6±18.9      | 65.5±19.2      | 0.586 |
| Perforation (+), n (%)                      | 16 (27.1)      | 18 (29.5)      | 0.841 |
| Intraoperative complications (n)            | 0              | 0              | 1     |
| Postoperative complications, n (%)          | 3              | 4              |       |
| Intra-abdominal abscess                     | 1 (1.7)        | 1 (1.6)        | 0.958 |
| Bleeding                                    | 0              | 0              |       |
| Ileus                                       | 1 (1.7)        | 2 (3.3)        |       |
| Wound infection                             | 1 (1.7)        | 1 (1.6)        |       |
| Clavien–dindo classification, n (%)         |                |                |       |
| Grade I                                     | 1 (1.7)        | 2 (3.3)        | 0.650 |
| Grade II                                    | 2 (3.4)        | 1 (1.6)        |       |
| Grade III                                   | 0              | 1 (1.6)        |       |
| Pathologic diagnosis, n (%)                 |                |                |       |
| Acute appendicitis without purulent exudate | 34 (57.6)      | 28 (45.9)      | 0.307 |
| Acute suppurative appendicitis              | 19 (32.2)      | 28 (45.9)      |       |
| Acute gangrenous appendicitis               | 6 (10.2)       | 5 (8.2)        |       |
| Hospital stay (day)                         | 3.07±1.14      | 2.90±1.18      | 0.435 |

Data are presented as mean±SD or as the n (%). SD=Standard deviation

accepted by most patients. Different methods for the closure of appendicular stump were compared.<sup>6-9</sup> Studies showed no significant differences in intra-abdominal abscess or operative time. Rare cases of migration of endoclips or polymetric clips were reported.<sup>13-15</sup> Despite their relatively low incidence, the complications can be lethal.

Postoperative leakage or bleeding is a major concern for most surgeons. In this study, no patient was readmitted after an initial operation. The absorbable clip group showed noninferior surgical time and other related postoperative complications compared to the traditionally used metallic clip group. In addition, imaging studies play an important role in the current medical practice. Metallic clips from previous surgeries sometimes interfere with the interpretation of the imaging studies, including X-ray, computerized tomography, and magnetic resonance imaging. In contrast, absorbable polymetric clips are efficacious in closing the appendicular stump and artery, with the benefits of no foreign body after being fully degraded.

This study has some limitations. First, absorbable clips are relatively new to our center, and the sample size was relatively small. Second, this is a retrospective single-center study, so the

results might have clinicopathological biases. Furthermore, all absorbable clips were used by a single surgeon, whereas metallic clips were used by other surgeons. There may be some differences in surgical techniques used by the surgeons that may influence the results.

## CONCLUSION

LA is well-established for treating acute appendicitis. The use of absorbable polymetric clips in the closure of appendicular stump and ligation of appendiceal artery showed similar postoperative complications and hospital stay length. With the benefits of leaving no foreign body, LA may reduce long-term foreign body-related complications. Absorbable clips seem to have the potential as the optimal tool to secure the base of the appendix and appendiceal artery.

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## Conflicts of interest

There are no conflicts of interest.

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