Acute appendicitis is the most frequent problem which needs to be treated with emergency surgery throughout the world.\(^1\) Non-perforated appendicitis is still primarily treated with laparoscopic surgery.\(^2\)

Appendiceal stump closure is an important stage of appendectomy in terms of avoidance of severe complications like postoperative fistula, peritonitis and sepsis.\(^3\) Many types of techniques and materials have been introduced for appendiceal stump closure, such as staplers, Endoloop\(^\text{TM}\), titanium clips, non-absorbable polymer clips, extracorporeal sliding knot, intracorporeal ligation and Ligasure\(^\text{TM}\).\(^4,5\) At the institution where this study was conducted, polymeric clips are used to secure the appendiceal base, as described in the literature. This study was conducted to investigate the outcome of appendectomy carried out by using polymeric clips for stump closure.

A retrospective review of 123 patients was conducted who had undergone laparoscopic appendectomy with polymeric clips (Hem-o-lok, Weck Polymer Locking Ligation System, Teleflex, Research Triangle Park, North Carolina, USA). Inclusion criteria were being aged 18 years or older and having laparoscopic appendectomy for appendicitis. The diagnosis of appendicitis was made by a surgeon, evaluating history and imaging with ultrasound (US) or computerized tomography (CT). Exclusion criteria were age younger than 18 years and presence of signs of appendiceal rupture or abscess on preoperative imaging or during surgery.

Surgery was performed by using standard 3-port laparoscopic appendectomy techniques and polymeric clips were utilized for ligation of all appendiceal bases. X-large clips were applied by means of a clip applier placed through a 10-mm port. Two clips were placed on the appendiceal stump, and one clip was placed toward the specimen side of the appendix, prior to a sharp dissection of the appendix. The surgeon decided the techniques of tissue dissection and mesoappendix ligation; the most frequently used techniques were bipolar vessel-sealing technology and monopolar electrocautery dissection. Electrocautery was employed for fulguration of the appendiceal stump exposed (Figures 1a-d).

An evaluation of data about death, surgery-related complications like appendiceal stump dehiscence, presence of signs of appendiceal rupture or abscess on preoperative imaging or during surgery.

**Figure 1:** (a) Stripping the appendiceal stump and preparing it for clipping after dissection of the meso-appendix, (b) Clipping the appendiceal stump, (c) Incision and cautery of the stump. Appendiceal material clipped at its distal part and seen separately in the right lower quadrant, (d) Surgical specimen.
Patients' comorbid diseases accompanying appendicitis under-

661

661

fever. The most encountered postoperative complication

had abdominal pain, one had distension and one had

patients, eight had swelling and pain at the port site, four

again in the early postoperative period. Out of 14

using clips. Fourteen patients presented to hospital

(1.6%) during traction and it was kept under control by

were observed to have bleeding in the mesocolon

in addition to laparoscopic appendectomy. Two patients

cholecystectomy, two patients had tubal abscess

evaluation. A total of 49 patients were excluded since 19

diagnosis of acute appendicitis were retrospectively

hospital between January 2012 and September 2016

Data about 172 patients admitted to Baskent University

and undergoing laparoscopic appendectomy for the
diagnosis of acute appendicitis were retrospectively

evaluated. A total of 49 patients were excluded since 19

patients had perforation or abscess detected through

imaging methods or during surgery, 27 patients had

ligation, 2 patients had endostapler and 1 patient had

open appendectomy due to severe adhesions. A total of

123 patients had laparoscopic appendectomy with

polymeric clips (68 females and 55 males). The median

operation time was 45 minutes (minimum 15, maximum120 minutes). The median age of these

patients was 35 years (minimum 19, maximum 81

years). The median WBC count was 13400 (minimum

4.600, maximum 33.500)x10^3/µL and the median

follow-up duration was 23 months (minimum 4, maximum 59 months).

Diseases accompanying appendicitis are

presented in Table I.

Five patients had ovarian cystectomy, three patients had

cholecystectomy, two patients had tubal abscess

drainage and two patients had excision of endometrioma

in addition to laparoscopic appendectomy. Two patients

were observed to have bleeding in the mesocolon

(1.6%) during traction and it was kept under control by

using clips. Fourteen patients presented to hospital

again in the early postoperative period. Out of 14

patients, eight had swelling and pain at the port site, four

had abdominal pain, one had distension and one had

fever. The most encountered postoperative complication

was infection of port-site entrance and coincided with 5

patients (4%). Suture reaction was encountered with 2

patients (1.6%), hematoma or collection in the umbilical

port-site were also seen on 2 patients (1.6%). One

patient had early postoperative ileus and one patient

had pulmonary atelectasia as the most unusual

complications (0.8%,0.8% respectively). One hundred

and twelve patients experienced no complications. The

patient presenting with fever was found to have

pulmonary atelectasis, which rapidly healed through

respiratory hygiene. One patient, having ileus in the

early postoperative period felt relieved following one-
day hospitalization. The remaining 12 patients were

administered antibiotics for the complications (enteral
dose of 500 mg cefazoline twice a day). None of the

patients had intraabdominal collection of pus or

abscess. The mean LOS was 1.4 ±0.7 days (range: 1-5

days). One hundred and eleven patients had acute

appendicitis; and 12 patients had appendicitis resulting

from different sources. Two patients' appendicitis were

related with endometriosis and 2 with mucinous

neoplasm. One patient's appendicitis was related with

intra-uterin device, 1 with treadworm, 1 with acute
eosinophilic infiltration. The median follow-up duration

was 23 months (minimum 4, maximum 59 months).

It has been reported that laparoscopic appendectomy is

a safe alternative to open surgery for treatment of acute
appendicitis.2 As well as clinical advantages, laparoscopy

gives an opportunity to explore the peritoneal cavity

completely. It is considered significant in terms of
diagnosis of acute appendicitis or accompanying

conditions. In fact, such conditions as pelvic

inflammatory disease, endometriosis, ovarian cysts,
etopic pregnancy, cholecystitis and colonic perforation

can imitate appendicitis.1

There are different alternatives to close appendiceal
stump. They include the use of mechanical endostaplers,
endoligature (endo-loop), metal clips, bipolar endo-
coagulation, polymeric clips and intracorporeal sutures,2,5,6-9

Table I: Patients' comorbid diseases accompanying appendicitis under-

going laparoscopic appendectomy with polymeric clips.

<table>
<thead>
<tr>
<th>Patients' comorbidities</th>
<th>Number of patients (n)</th>
<th>percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery disease</td>
<td>7 (5.7%)</td>
<td></td>
</tr>
<tr>
<td>Neurological disorders</td>
<td>4 (3.2%)</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>3 (2.4%)</td>
<td></td>
</tr>
<tr>
<td>Hematological disorders</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Chronic hepatic disorders</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Morbid obesity</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Pregnancy</td>
<td>2 (1.6%)</td>
<td></td>
</tr>
<tr>
<td>Rheumatological disorders</td>
<td>1 (0.8%)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>95 (77%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>123 (100%)</td>
<td></td>
</tr>
</tbody>
</table>
There have not been any prospective randomized studies comparing these methods.

The method of choice for appendiceal stump closure should be inexpensive and easy to perform. However, other factors like surgeons’ training and experience, availability of equipment needed and the size of appendix inflammation play a role in decisions about the best method.\(^5\) Polymeric clips provide considerable cost savings as compared with endoscopic staplers, and are easy to apply in comparison to suture ligature techniques. In recent years, there have been several studies showing effectiveness of using polymeric clips for transection of the appendix.\(^2,9,10\) Baskent University Hospital, where the present study was conducted, pay $11 for each clip and $300 for each endostapler. Considering that no major complications occurred in the present patient group, closure of the appendiceal stump with clips is very cost-effective.

Theoretically, they may cause complications as chronic pain, granulomas, migration, and foreign body reactions since they are produced from non-absorbable material.\(^1\) None of the above mentioned complications were observed in the long-term follow-up of the present study.

In conclusion, it is easy, rapid and inexpensive to use hem-o-lok clips and they offer a safer closure of the appendiceal stump. For these reasons, hem-o-lok clips are preferred as the technique of choice to close the appendiceal stump in uncomplicated appendicitis in our clinic.

REFERENCES