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Clinical Outcome of Retrograde Laparoscopic Appendicectomy Using Single Hem-O-Lock Clip for Complicated Versus Non-Complicated Appendicitis

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Abstract

Background: Laparoscopic appendicectomy is safe and feasible for non-complicated appendicitis. The use of retrograde appendicectomy allows feasibility also for complicated cases. Using single polymer clip for securing appendicular stump is safe as well as two clips.
Objectives: To evaluate the clinical outcome of using single Hem-O-Lock polymer clip and to compare technical feasibility of retrograde laparoscopic appendicectomy for complicated versus non-complicated appendicitis in adults.
Patients and Methods: A single institute prospective study was done between August 2012 and April 2014. From 78 patients presenting with acute appendicitis to emergency unit, Zagazig University hospitals, only 60 patients were eligible. Three retrograde laparoscopic appendicectomy ports were used in both groups (group I, complicated appendicitis and group II, non-complicated appendicitis) and a single Hem-O-Lock polymer clip was applied to secure the appendicular stump. Standardized data collection was performed and data collected by the attending resident and attending physician. The primary clinical outcome was the severity of pain at 1 - 7 days. Secondary outcomes included the duration of operation (minutes), procedure-related complications, conversion rates, and length of hospital stay.
Results: Four patients (15.4%) were converted to open surgery; three patients in group I and one in group II. Four patients developed postoperative complications; three patients in group I and one in group II. Operative time was less in group II and was statistically different and the P value was significant < 0.001. The difference in conversion rates and post-operative complication between two groups is not statistically significant with a $P > 0.05$.
Conclusions: Retrograde laparoscopic appendicectomy using single polymer clip makes easy access to operating in complicated and non-complicated appendicitis.

Keywords: Complicated Appendicitis, Polymer Clips, Laparoscopic Appendicectomy

1. Background

The real challenge in laparoscopic appendicectomy (LA) is considered to be those patients where the appendix is complicated forming a mass, abscess, gangrenous or there are firm adhesions making its skeletonization difficult by laparoscopic means (1-3).

The proper management technique of complicated appendicitis is more controversial. LA in complicated cases can be technically demanding procedure thus it necessitates a special approach to deal with. Retrograde appendicectomy allows early access to the appendicular base and prevents inadvertent injury to cecum especially in cases where the tip is buried in a mass (4, 5).

Hem-o-lock clip is a non-absorbable polymer clip with a lock-engagement feature as well as teeth within the jaws, all of which provide greater security (6, 7). Using single polymeric clip for the closure of appendicular stump is safe, feasible and easy applicable and can be a standard method in LA for complicated and non-complicated appendicitis for all ages (8).

2. Objectives

The clinical significance and rational of the study was to assess the clinical outcome and effect of using single Hem-O-Lock polymer clip and to compare technical feasibility of retrograde laparoscopic appendicectomy for complicated versus non-complicated appendicitis in adults.

3. Patients and Methods

A prospective study was done between August 2012 and April 2014, 78 patients were diagnosed clinically. labora-

tory (elevated total leukocyte count (TLC), elevated C reactive protein (CRP) and radiologically by Pelvi-abdominal ultrasonography (US)), and finally the most diagnostic issue is the CT abdomen and pelvis which issued for patients with suspected complicated appendix when the US is not conclusive or negative.

Patients were categorized into two groups, group I included 26 patients with complicated appendicitis (appendicular mass, gangrenous and perforated appendix). Group II included 34 patients with non-complicated appendicitis.

Inclusion criterion was all patients with acute appendicitis above 18 years old.

We excluded patients with previous pelvic surgery, pediatric and old aged patients, previous open abdominal surgery through midline surgery, patients with markedly inflamed or gangrenous appendicular base, patients unable to consent or refused laparoscopic intervention, and patients unfit for anesthesia.

All patients signed a consent for possible conversion to open technique.

3 ports were used; the first or the optical trocar was a 10 mL trocar. The second port at the left mid-clavicular line 10-mm was at the level between the umbilicus and supra-pubic port for the introduction of clip applier, and the third port was 5mm supra-pubic for the grasper.

Firstly, the appendix base and tip were identified and visualized and any part of the appendicular shaft was holded with the grasper, especially in the complicated appendix (Figures 1 and 2), Told's line was used to incise for dissection of appendicular mass. The appendix was freed, a window was done in the mesoappendix beside and adherent to the base, clip applier introduced and fired a single Hem-O-Lock polymer clip (L.XL clips) at the appendicular base (Figures 3 - 4), Patients with markedly inflamed or gangrenous appendicular base were excluded from clipping for patient safety and fear of cut through, another titanium or polymer clip was applied distally.

The appendix was transected between the proximal and distal clip. Then, the mesoappendix was divided using bipolar diathermy (Figures 5 and 6). In complicated appendicitis, the division of the thick inflamed mesoappendix was challenging.

Patients had a Jackson-Pratt drain placed in the pelvis for complicated cases only.

Postoperative analgesia administrated using paracetamol, Diclofenac and Morphine. Perioperative intravenous antibiotics were administered using 3rd generation cephalosporin.

Patients initiated diet within 6 hours postoperatively except four patients which initiated after 24 hours.

Data collection, parameter measure and Follow-up: standardized data collection was performed and data were collected by the attending resident and attending physician and each patient was evaluated at the hospital outpatient clinic for 2 months.

All patients before discharge and before giving the sick leave were requested to return to the outpatient clinic ev-

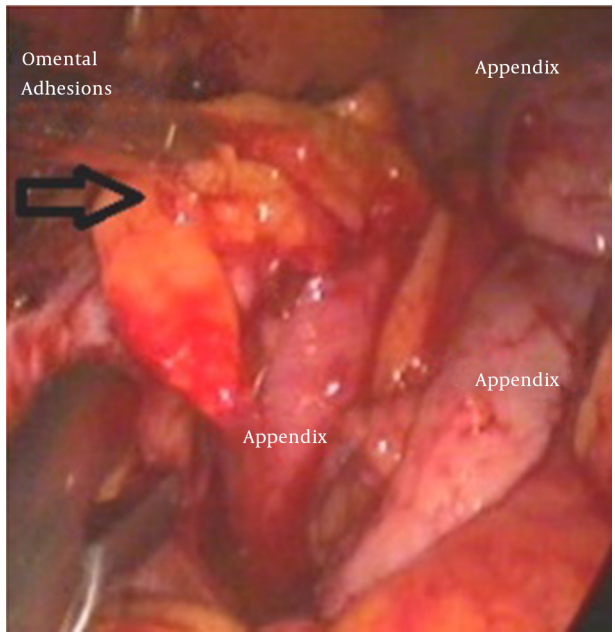

Figure 1. Appendicular Mass

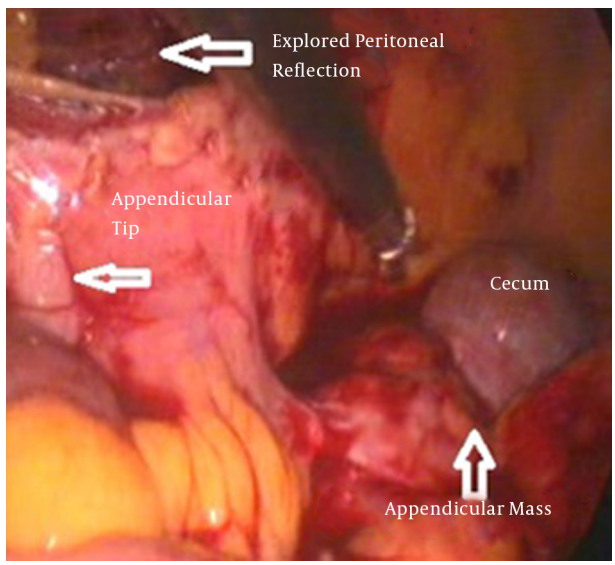

Figure 2. Appendicular Mass

Figure 3. Single Polymer Clip

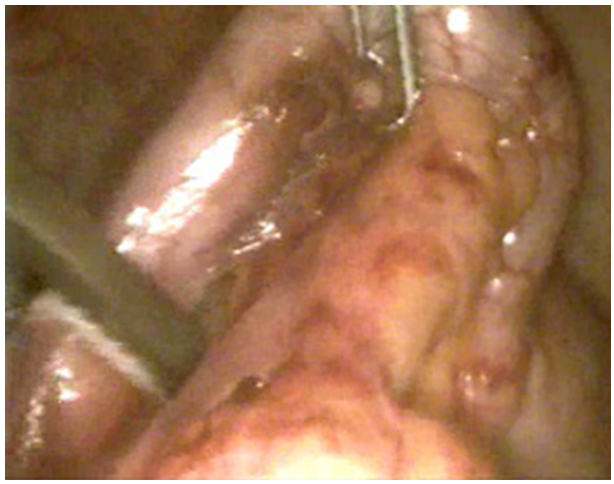

Figure 4. Single Clip Application

Figure 5. Appendix Suspended From Mesoappendix

Figure 6. Bipolar Division of Mesoappendix

ery week for the first month and every two weeks for the next month for a standardized examination and follow-up.

All patients were assessed for postoperative pain, distension, fever, any signs of infection and port site infection.

3.1. Statistical Analysis

Continuous variables were expressed as the mean ± SD and median (range). The categorical variables were expressed as a number (percentage). Continuous variables were checked for normality by using Shapiro-Wilk test. Mann-Whitney U was used to compare two groups of non-normally distributed data. Percent of categorical variables was compared using the Pearson's Chi-square test or Fisher's exact test when appropriate. All tests were two sided. $P < 0.05$ was considered statistically significant. All data were analyzed using Statistical Package for Social Science for windows version 18.0 (SPSS Inc., Chicago, IL, USA) & MedCalc for windows version 13 (MedCalc Software bvba, Ostend, Belgium).

4. Results

This study began on August 2012 and concluded in April 2014. 78 patients aged 18 years and above diagnosed with appendicitis were admitted to the unit. Only 60 patients formally approached: from total 78 patients, four old aged patients and sex pediatric population excluded, three

patients were ineligible due to precious open abdominal surgery through midline, and five patients were ineligible due to gangrenous appendicular base. Sixty patients were eligible and agreed to take part in the study and they were categorized into two groups.

In group I, 16 male patients (61.5%) and 10 female patients (30.8%) underwent surgery. In group II, 13(61.5%) patients were male and 21 patients (61.8%) were female.

Patients ages ranged from 18 to 41 years; where in group I ranged from 24 to 41 with mean ± SD 27.5 ± 7.4 years and in group II ranged from 18 to 36 with a mean± SD 25.8 ± 8.5 years and the P value was 0.420, Table 1.

Patients in group I were 10 cases with appendicular mass (34.5%), 8 cases with perforated appendix at the tip (30.8%), four cases perforated shaft appendix (15.4 %), and four cases with gangrenous appendix with healthy base (15.4%).

Outcomes, conversion rate and surgery related complications: the primary clinical outcome was severity of pain using the pain numerical rating scale (NRS) at 1 - 7 days. Secondary outcomes included duration of operation (minutes), procedure related complication rates, conversion rates, hospital re-admission and time to return to normal activities.

Morphine used during immediate recovery was less in participants in non-complicated group. Morphine dose was similar in both groups when given. There was no difference in the use of postoperative analgesia on the ward. Similarly, there was no statistical difference in patient-reported pain on days 1 - 7, Table 2.

On average, laparoscopy for non-complicated cases was quicker with the total operation time being 15 minute shorter, with mean ± SD 55.4 ± 12.6 minutes in group I and mean ± SD 40.5 ± 10.5 minutes in group II, the P value was significant < 0.001, Table 3.

All cases were completed laparoscopically except four patients (15.4%). In group I, three patients converted to open technique, one patient had bleeding and field obscured. In other two patients, it was difficult to localize the appendix where it was hidden into the large mass so we converted it to open surgery. In group II, one patient found to have inflamed meckel's diverticulum with wide base necessitated resection. There was no statistically significant difference between two groups regarding conversion.

Four patients from the 60 patients (15.4%) had postoperative complications. In group I, three patients (11.5%) developed intra-abdominal abscess postoperatively. In group II, one patient (2.9%) developed port site infection. The difference in conversion rates and post-operative complication between two groups was not statistically significant with P > 0.05, Table 4.

Patients who developed intra-abdominal abscess postoperatively, managed as follow. One of them underwent laparoscopic drainage during the same admission, the other two patients readmitted after one to two weeks, and one of them underwent US-guided drainage and the last one improved within 72 hours with the use of third-generation cephalosporin's and Metronidazole. Patient, who developed port site infection, was at the left midclavicular port and the patient improved with 3rd generation cephalosporin antibiotic and dressing.

No other complications were noted. None of these patients were readmitted for port site hernia or postoperative bleeding. The postoperative course of all patients was uneventful except the patients that developed the postoperative intraabdominal abscess.

The mean length of hospital stay after surgery was 3.5 ± 2.4 days in group I and 2.3 ± 1.4 in group II. This was not statistically significant between the two groups, Table 5.

4.1. Initiation of Diet

Patients initiated diet as tolerated (DAT) within 6 hours from operation except four patients; two of them presented ileus due to prove intra-abdominal abscess, the other two patients started oral after 24 hours and these were the patients converted to open technique and had difficulty dissecting the appendicular mass.

5. Discussion

Laparoscopic appendicectomy is still a matter of concern for complicated appendicitis. Our study's main objective was to prove the technical feasibility of laparoscopy for complicated and non-complicated appendicitis using retrograde approach. Laparoscopy can be a main therapeutic procedure compared with open appendicitis in complicated and non-complicated cases and this is comparable with many studies (9). Other studies (10) still recommended the open approach for complicated appendicitis when confirmed well with imaging studies. This is not issued in our study where most of those cases (84.6%) were successfully treated laparoscopically.

Preoperative CT abdomen and pelvis are of utmost importance to confirm diagnosis of complicated appendicitis specially and this was comparable with many studies (11, 12) where they necessitated the role of CT and Alvarado scoring system to decrease a rate of negative appendicectomy.

Many updated studies (13, 14) recommended immediate surgery for appendicular mass by open surgery versus laparoscopic approach and using a single incision adds more and more advantage to the laparoscopic approach, as early operation on the other hand has the benefit of being

Table 1. Demographic Data[a]

Demographic Data	Type of Appendicitis		P Value
	Complicated (n = 26)	Non Complicated (n = 34)	
Age, y			0.420
Mean ± SD	27.5 ± 7.4	25.8 ± 8.5	
Median (range)	27 (24 - 41)	25 (18 - 36)	
Sex			0.073
Male	16 (61.5)	13 (38.2)	
Female	10 (38.5)	21 (61.8)	

[a] n = Total number of patients in each group; quantitative data were expressed as the mean ± SD.

Table 2. Postoperative Pain and Use of Analgesia[a,b]

Postoperative Pain and Use of Analgesia	Type of Appendicitis		Difference (95% CI)	P Value
	Complicated (n = 26)	Non Complicated (n = 34)		
Postoperative analgesia in recovery room				0.455
Paracetamol	12 (46.2)	19 (55.9)	9.7 (0 - 26.9)	
Morphine	14 (53.8)	15 (44.1)	9.7 (0 - 45.2)	
Postoperative analgesia in ward				
Paracetamol	10 (38.5)	19 (55.9)	17.4 (0 - 18.1)	0.181
Diclofenac	14 (53.8)	15 (44.1)	9.7 (0 - 45.2)	0.455
Morphine	2 (7.7)	0 (0)	7.7 (0 - 17)	0.184
Patient reported pain during 1 - 7 days post-operation				
No pain	4 (15.4)	7 (20.6)	5.2 (0 - 16.6)	0.742
Pain when resting	10 (38.5)	18 (52.9)	14.4 (0 - 20.4)	0.265
Pain when moving	12 (46.2)	9 (26.5)	19.6 (0 - 49.8)	0.113

[a] n = Total number of patients in each group; qualitative data were expressed as a No.(%); 95%CI, 95% confidence interval.
[b] P < 0.05 is significant.

Table 3. Operative Time[a,b]

Demographic Data	Type of Appendicitis		P Value
	Complicated (n = 26)	Non Complicated (n = 34)	
Operative time, min			< 0.001[c]
Mean ± SD	55.4 ± 12.6	40.5 ± 10.5	
Median (range)	50 (40 - 70)	42 (30 - 65)	
< 40 minutes	1 (3.8)	17 (50)	< 0.001[d]
40 - 55 minutes	18 (69.2)	12 (35.3)	0.009[d]
≥ 55 minutes	7 (26.9)	5 (14.7)	0.241[d]

[a] n = Total number of patients in each group; quantitative data were expressed as the mean ± SD; qualitative data were expressed as a No (%).
[b] P < 0.05 is significant.
[c] Mann Whitney U test.
[d] Chi-square test.

Table 4. Complication and Causes of Conversion[a,b]

Technical Difficulties and Post-Operative Complication	Type of Appendicitis		Difference (95% CI)	P Value
	Complicated (n = 26)	Non Complicated (n = 34)		
Technical difficulties				
Bleeding	1 (3.8)	0	3.8 (0 - 10.4)	0.433
Trauma to neighboring	0	0	-	1.000
Difficult localization of appendix	2 (7.7)	0	7.7 (0 - 17)	0.184
Post-operative complications				
Port site infection	0	1 (2.9)	2.9 (0 - 3.6)	1.000
Port site hernia	0	0	-	1.000
Port site bleeding	0	0	-	1.000
Residual intra-abdominal abscess	3 (11.5)	0	11.5 (0 - 22.9)	0.076

[a] n = Total number of patients in each group; qualitative data were expressed as a No.(%); 95%CI, 95% confidence interval.
[b] P < 0.05 is significant.

Table 5. Hospital Stay[a]

Hospital Stay	Type of Appendicitis		P Value
	Complicated (n = 26)	Non Complicated (n = 34)	
Hospital stay (days)			
Mean ± SD	3.5 ± 2.4	2.3 ± 1.4	0.018
Median (range)	2 (1 - 6)	1 (1 - 4)	
1 day	22 (84.5)	33 (97.1)	0.156
2 - 3 days	0 (0)	0 (0)	1.000
> 3 days	4 (15.3)	1 (2.9)	0.156

[a] n = Total number of patients in each group; quantitative data were expressed as the mean ± SD; qualitative data were expressed as a No (%); P < 0.05 is significant.

curative in the index admission and ensures early return-to-work and higher compliance and this is in line with our study but we used 3 ports instead of the single port.

Conversion to open technique is not a sign of failure but we documented four cases converted to open technique (4%) in both groups and no statistically significant difference between the two groups and this is comparable with a study done by Taylor et al. (15) who reported a 5.5% conversion rate but his study was conducted for pediatric population whose ages ranged from eleven to fifteen years old which is less than our patients' ages.

There was no difference in the use of postoperative analgesia on the ward. Similarly, there was no statistical difference in patient-reported pain on days. In spite of issuing the pain as a primary outcome study, the study agreed with many international studies that pain is related to the pathology (complicated appendicitis not to the technique) in them.

We reported an incidence of 11.5% in postoperative intra-abdominal abscess. The accepted percentage was supported by the use of the accepted method of dissection by the retrograde approach and the use of the easy applicable single Hem-O-lock clip polymer clip, only one proximal clip surely completed lumen closure as strong as 2 clips but it is advantageous over 2 clips in being less time consuming and less cost, all of which may provide greater security. Its disadvantage is that the lock of the clip is very strong and can cause cut through if used over markedly inflamed or friable tissue. Another disadvantage is lacking of the radio-opaque material which is not a matter of concern in laparoscopic appendicectomy but critique in biliary surgery. There are several methods for ligation of appendicular stump during laparoscopic appendicectomy. Many studies showed the safety and cost of the different devices in different situations. Each technique has its own potential advantage and disadvantage. Endo-GIA staplers are expensive instruments. Titanium clips may be slipped from its primary position (6, 7).

In a study done by Yagnik et al., (16) a total of 452 patients were operated with classic antegrade laparoscopic appendicectomy. There were 362 (80.1%) uncomplicated appendicitis (group I) and 90 (19.1%) complicated appendicitis (group (II)). The intraabdominal abscess rate was 14.35% in group I and 19.5% in group II. This incidence is higher than our incidence. In another study, conducted and reported by Nasher et al., (17) comparing retrograde LA to open appendectomy for complicated cases in a younger age group, no IAA occurred after LA. In other studies (18)

overall infection rate including surgical site infection and IAA was 2.54% in uncomplicated cases and 7.32% in complicated cases and these results were better than our results.

Partecke et al., (19) had a prospective randomized study on 101 patients over a 1 year study period for both complicated and un-complicated cases and a single Hem-o-lock ML-LX polymeric clip was applied. He found less incidence of postoperative intra-abdominal abscesses and surgical site infection (8.9%) and he attribute his results to both the laparoscopy and the single polymer clip used. It is partially similar to our study but we used less number of patients in a larger period of time. Also it's comparable with other authors (20, 21) who confirmed the safety of polymer clip usage in laparoscopic appendicectomy for complicated appendix.

5.1. Conclusion

Laparoscopic retrograde appendicectomy is technically feasible, allows easy access to the appendix and avoids excessive unnecessary dissection in complicated appendicitis and its results were accepted especially with the use of single polymer clips which ensure secure closure of stump in complicated as well as uncomplicated appendicitis.

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