

Comparative Study of the Clinical Outcome of Retrograde Laparoscopic Appendectomy Using a Single Polymer Clip for Complicated Versus for Non-Complicated Appendicitis

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Abstract

Objective: To evaluate the clinical outcome of using single Hem-O-Lock polymer clip and compare technical feasibility of retrograde laparoscopic appendectomy for complicated versus non-complicated appendicitis in adults.

Methods: A single institute prospective study of 78 patients presenting with acute appendicitis. Only 60 patients were eligible, 3 port retrograde laparoscopic appendectomy were used in both groups and a single Hem-O-Lock polymer clip applied to secure the appendicular stump. 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 in group I and one patient in group II. Four patients developed postoperative complications, three in group I and one patient in group II. Operative time was less in Group II. The difference in conversion rates and post-operative complication between two groups is statistically not significant with a P value > 0.05.

Conclusion: Retrograde laparoscopic appendectomy using single polymer clip make easy access operating complicated as well as non-complicated appendicitis.

Keywords: Complicated appendicitis; Polymer clips; Laparoscopic appendectomy

Introduction

The real challenge in laparoscopic appendectomy (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 had been more controversial. LA in complicated cases can be technically demanding procedure thus necessitated a special approach to deal with. Retrograde appendectomy allows early access to the appendicular base and prevent 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 a safe, feasible and easy applicable and can be a standard method in LA for complicated and non-complicated appendicitis for all age [8].

Patient and method

Between August 2012 and April 2014, a 78 patients presenting to our University Hospitals in emergency unit (ER) with acute appendicitis were diagnosed by (clinical examination, fever, elevated total leukocyte count (TLC), elevated C Reactive protein (CRP), 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 criteria: All patients with acute appendicitis above 18 years old were included in the study.

Exclusion criteria: Included 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 consent for possible conversion to open technique.

Technique

A 3 port were used; the first or the optical trocar was a 10 ml trocar, the other 2 trocars inserted under complete vision. The second port at the left mid-clavicular line 10 mm at the level between the umbilicus and supra-pubic port for the introduction of clip applicator and a third port 5 mm supra-pubic for the grasper.

Firstly the appendix base and tip were identified and visualized, any part of the appendicular shaft were holded with the grasper, especially in the complicated appendix (Figures 1 and 2), Told's line incised for dissection of appendicular mass or for drainage of an appendicular abscess. The appendix is freed, a window was done in the mesoappendix beside and adherent to the base, clip applicator introduced and fired a single Hem-O-Lock polymer clip (L.XL clips) at the appendicular base (Figures 3 and 4), Patients with markedly

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inflamed or gangrenous appendicular base were excluded from clipping for patient safety and fear of cut through, another titanium or polymer clip applied distally. The appendix is transected between the proximal and distal clip, then the mesoappendix was divided using bipolar diathermy (Figures 5 and 6), in complicated appendicitis it was challenging for division of the thick inflamed mesoappendix. Patients have a Jackson-Pratt drain placed in the pelvis after completion of the appendectomy for complicated cases only. Postoperative analgesia administrated using paracetamol, Diclofenac and Morphine. Perioperative intravenous antibiotics are administered using 3rd generation cephalosporin. Patient initiated diet within 6 hours postoperatively except four patients, initiated after 24 hours.

Data collection, parameter measured and follow-up

Standardized data collection was performed on a prospective database, the data collected by the attending resident and attending physician and each patient were 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 every week for the first months 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.

Statistical analysis

Continuous variables were expressed as the mean \pm 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 were compared using the Pearson's Chi-square test or Fisher's exact test when was appropriate. All test 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).

Results

Study began on August 2012 and concluded April 2014. 78 patients aged 18 years and above diagnosed with appendicitis were admitted to the unit. Only 60 patients formally approached of 78 patients, four old

aged patients and sex pediatric population excluded, three patients were ineligible due to previous open abdominal surgery through midline, Five patients with gangrenous appendicular base. Sixty patients were eligible and agreed to take part in the study and they were randomized into two Groups.

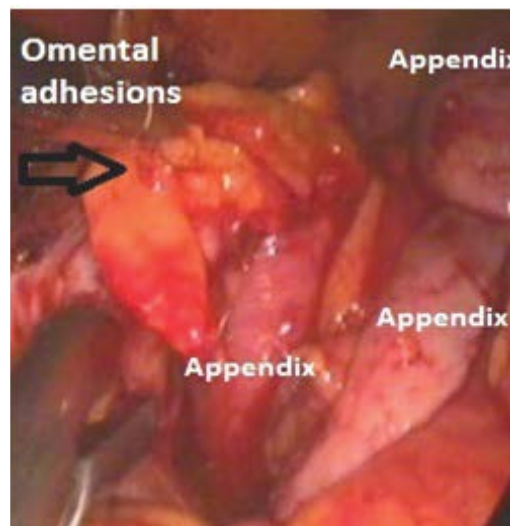


Figure 2: Appendicular mass.



Figure 3: Perforated appendicular tip.

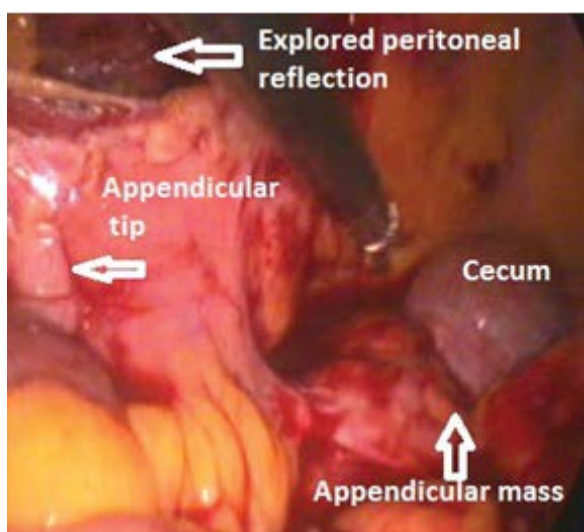


Figure 1: Appendicular mass.



Figure 4: Single polymer clip.



Figure 5: Meso-appendix.



Figure 6: Bipolar + second clip.

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

Patient age ranged from 18 to 41 years , where in Group I ranged from 24 to 41 with mean \pm SD 27.5 \pm 7.4 years and in Group II ranged from 18 to 36 with a mean \pm SD 25.8 \pm 8.5 years and the P value was 0.420 \ddagger (Table1).

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%) four cases with gangrenous appendix with healthy base (15.4%).

On average, Laparoscopy for non-complicated cases was quicker with the total operation time being 15 minute shorter, with mean \pm SD 55.4 \pm 12.6 minutes in Group I and mean \pm SD 40.5 \pm 10.5 minutes in Group II, The P value was significant <0.001 \ddagger (Table 2).

Outcomes, Conversion rate and Surgery related complication: 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.

Age (years)			
Mean \pm SD	27.5 \pm 7.4	25.8 \pm 8.5	0.420
Median (range)	27 (24 – 41)	25 (18 – 36)	
Sex			
Male	16 (61.5%)	13 (38.2%)	0.073
Female	10 (38.5%)	21 (61.8%)	

N=Total number of patients in each group; Quantitative data were expressed as the mean \pm SD.

Table 1: Baseline characteristics and demographic date.

Operative time	Type of appendicitis		p-value
	Complicated (N= 26)	Non complicated (N= 34)	
Operative time (min.)			
Mean \pm SD	55.4 \pm 12.6	40.5 \pm 10.5	<0.001 \ddagger
Median (range)	50 (40 – 70)	42 (30 – 65)	
< 40 minutes	1 (3.8%)	17 (50%)	<0.001 \S
40 – 55 minutes	18 (69.2%)	12 (35.3%)	0.009 \S
\geq 55 minutes	7 (26.9%)	5 (14.7%)	0.241 \S

N=Total number of patients in each group; Quantitative data were expressed as the mean \pm SD; Qualitative data were expressed as a number (percentage); \ddagger Mann Whitney U test; \S Chi-square test; p< 0.05 is significant.

Table 2: Operative time.

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 the other two patients, there was marked difficulty in localizing the appendix where it was hidden into the large mass so we convert to open surgery. In Group II, one patient found to have inflamed meckels diverticulum with wide base necessitated resection, there is no statistical 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 is statistically not significant with P value > 0.05 (Table 3).

Patients 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 mid-clavicular port, 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 nor postoperative bleeding. The postoperative course of all patients was uneventful except the patients that developed the postoperative intraabdominal abscess.

Morphine use during immediate recovery was less in participant 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 4).

The mean length of hospital stay after surgery was 3.5 \pm 2.4 days in Group I and 2.3 \pm 1.4 in Group II. This is statistically not significant between the two Groups (Table 5).

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 (0%)	3.8% (0% – 10.4%)	0.433
Trauma to neighboring	0 (0%)	0 (0%)	---	1
Difficult localization of appendix	2 (7.7%)	0 (0%)	7.7% (0% – 17%)	0.184
Post-operative complications				
Port site infection	0 (0%)	1 (2.9%)	2.9% (0% – 3.6%)	1
Port site hernia	0 (0%)	0 (0%)	---	1
Port site bleeding	0 (0%)	0 (0%)	---	1
Residual intra-abdominal abscess	3(11.5%)	0 (0%)	11.5% (0% – 22.9%)	0.076

N=Total number of patients in each group; Qualitative data were expressed as a number (percentage); 95%CI: 95% confidence interval; p< 0.05 is significant.

Table 3: Complication and causes of conversion.

Postoperative pain and use of analgesia	Type of appendicitis		Difference- (95%CI)	p-value
	Complicated (N= 26)	Non complicated (N= 34)		
Post operative analgesia in recovery room				
Paracetamol	12(46.2%)	19 (55.9%)	9.7% (0% - 26.9%)	0.455
Morphine	14 (53.8%)	15 (44.1%)	9.7% (0% – 45.2%)	
Post operative 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

N=Total number of patients in each group; Qualitative data were expressed as a number (percentage); 95%CI: 95% confidence interval; p< 0.05 is significant.

Table 4: Postoperative pain and use of analgesia.

Hospital stay	Hospital stay		p-value
	Complicated (N=26)	Non complicated (N= 34)	
Holiday 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
> 3 days	4 (15.3%)	1 (2.9%)	0.156

N=Total number of patients in each group; Quantitative data were expressed as the mean ± SD; Qualitative data were expressed as a number (percentage); p< 0.05 is significant.

Table 5: Hospital stay.

Initiation of diet: Patients initiated diet as tolerated (DAT) within 6 hours from operation except four patients, Two of them presented with ileus due to proved intra-abdominal abscess, the other patients started oral after 24 hour and this was the patients converted to open technique whose has difficulty dissecting the appendicular mass.

Discussion

Laparoscopic appendectomy is still a matter of concern for complicated appendicitis; our study main objective was to prove the technical feasibility of laparoscopy for complicated as well as non-complicated appendicitis using retrograde approach. Laparoscopy can be a main therapeutic procedure than open appendicitis in complicated and non-complicated cases and this is comparable with many studies [9]. Other studies 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[10].

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

Many updated studies recommended immediate surgery for appendicular mass by open surgery versus laparoscopic approach and using a single incision adds a more and more advantage to the laparoscopic approach as early operation on the other hand has the benefit of being curative in the index admission and ensures early

return- to-work and higher compliance, and this agree with our study but we used 3 port instead of the single port[13,14].

Conversion to open technique is not a sign of failure but we documented a four cases converted to open technique (4%) in both groups and documented no significant statistical difference between the two groups and this is comparable with a study was 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 a lesser than our patient's ages.

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 ensure complete 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 the lacking of radio-opaque material which is not a matter of concern in laparoscopic appendectomy but critique in biliary surgery.

In a study done by Yagnik et al. [16], a total of 452 patients were operated with classic antegrade laparoscopic appendectomy. There was 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 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[18].

Partecke et al., [19] had a prospective randomized study on 101 patients over a 1 year study period for both complicated and uncomplicated cases; a single Hem-o-lock ML-LX polymeric clip was applied. He found that 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 comparable with Hue et al. and Cho et al. [20,21] who confirmed the safety of polymer clip usage in laparoscopic appendectomy for complicated appendix.

Conclusion and Recommendation

Laparoscopic retrograde appendectomy is technically feasible, allow easy access to the appendix and avoid excessive unnecessary dissection in complicated appendicitis and 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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