Laparoscopic versus conservative treatment of appendicular mass: outcome and benefit comparisons

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Context
Appendicular mass is one of the most common surgical problems and constitutes ~2–6% of cases presented with acute appendicitis. Management is still controversial, with three different approaches: emergency surgery, conservative management followed by interval surgery, and totally conservative management without interval surgery. Recently, laparoscopic appendectomy has become the preferred method in the management of acute appendicitis; however, its role in the management of complicated appendicitis is still debatable.

Aims
The current study aimed to assess the outcome, benefit, and feasibility of laparoscopic surgery versus conservative approach for management of appendicular mass.

Patients and methods
This double-blinded randomized controlled trial study included 60 patients with appendicular mass, recruited from the emergency unit at Sohag University Hospital during the period from January 2019 to February 2021. They were randomly assigned into two groups: group A patients underwent laparoscopic and group B patients underwent conservative management.

Results
There was a significant difference between groups A and B cases regarding hospital stay (group A, 6.6±0.7 days vs. group B, 10±1.6 days; $P<0.001$) and outcome, with respect to peritonitis (group A, 40% vs. group B 0%; $P<0.001$) and improvement (group A 100% vs. group B 40%; $P<0.001$). There was no significant difference between the two study groups regarding clinical picture.

Conclusions
Laparoscopic appendectomy is a feasible and safe approach in patients with early appendicular mass. Laparoscopic appendectomy for mass is a feasible and safe approach with better outcome and shorter hospital stay compared with conservative modality.

Keywords:
acute appendicitis, appendicular mass, laparoscopic and conservative appendicitis

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Introduction

Appendectomy is considered one of the commonest surgical operations with an incidence between 7 and 10% of all abdominal surgeries [1]. The first open appendectomy was described by McBurney [2], but with the advance of minimally invasive surgery, new approaches were used in the management of appendicitis [3]. An appendicular mass is an inflammatory tumor consisting of the inflamed appendix, its adjacent viscera, and the greater omentum. It is the usual sequelae of a walled-off appendiceal perforation and represents a wide pathological spectrum ranging from phlegmon to abscess [4,5]. It is one of the commonest surgical problems and constitutes ~2–6% of patients presented with acute appendicitis [1–6]. Management is still controversial with different approaches: emergency surgery, conservative management followed by interval surgery, and totally conservative management without interval surgery. In the new era, laparoscopic appendectomy has become the preferred method in the management of acute appendicitis; however, its role in the management of complicated appendicitis is still debatable [4–7].

Early surgical intervention has been a good alternative to conservative therapy that was followed for a long period [7]. Additionally, in 10–20% of the cases, conservative management is not sufficient, and the patients further require an emergency intervention because of peritonitis [8,9]. Furthermore, patients may experience a recurrent attack of appendicitis following discharge from the hospital [9,10].

Unfortunately, a large number of patients refuse surgical procedure once their acute problem is resolved, and this seems to be a major drawback of the initial conservative approach. Early intervention on the contrary is mostly curative in the index admission and ensures early recovery and higher compliance. Debate is not only restricted to the way of management but is also about technical method, laparoscopy versus open [11]. Open appendectomy has been the standard approach for all forms of appendicitis [12,13]. Since early 1980s, laparoscopic appendectomy has become an acceptable method for simple appendicitis [3,13]. However, its efficacy in the treatment of complicated appendicitis is controversial. The current study aimed to evaluate the safety and efficacy of laparoscopic appendectomy in patients with complicated appendicitis in our institution.

Patients and methods

This study was double-blinded RCT, conducted from January 2019 to February 2021. A total of 60 patients with clinically diagnosed appendiceal mass were recruited from the Surgical Department, Sohag University Hospital. Exclusion criteria for the current study were being patients with midline incision, pregnant women, or appendectomy that was performed as a part in a more extensive surgical procedure, that is, colorectal resection. Diagnosis of acute appendicitis was done clinically. Several methods have been suggested to diminish the diagnostic mistakes, such as ultrasound (US) (routinely done for all cases) and computed tomography (CT) (done for three obese patients) abdomen, if diagnosis is suspecting. It is not easy to differentiate between symptoms of appendicitis and gastroenteritis. Early symptoms may include vague bloating, indigestion, and mild abdominal pain, which generally is located around the umbilicus. As the infection progresses, pain becomes more prominent in the right lower quadrant and is usually associated with nausea, vomiting, and loss of appetite. The most accurate non-invasive method of diagnosis is abdominal US, but this is not totally reliable.

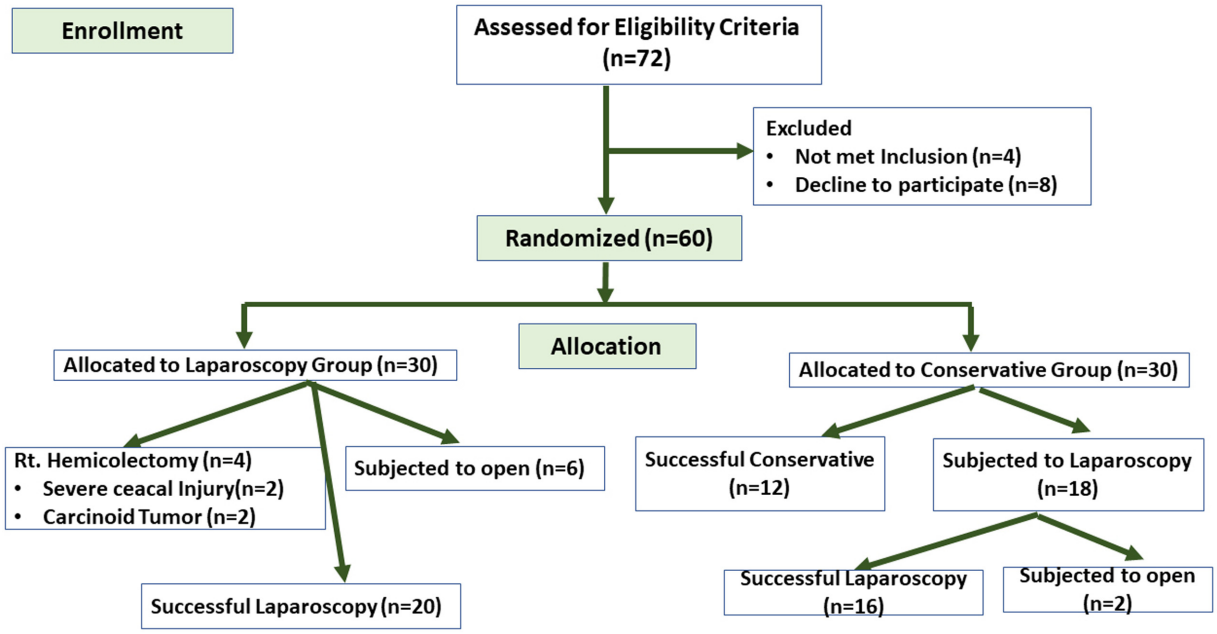
Till now, medical history and physical examination are considered the cornerstone for diagnosis, and this was the base for our assessment, but when intussusception and carcinoma of cecum were suspected, we performed CT abdomen and pelvis with contrast. Written consent was obtained from all eligible cases (patients with clinically diagnosed appendiceal mass) after detailed explanation about the study objectives, procedure, risks, and benefits. After completion of the baseline assessment, participants were randomly assigned to one of the two intervention groups: group A patients (n=30) underwent laparoscopic appendectomy, and group B patients (n=30) underwent conservative management. Allocation was conducted by random digit allocation using IBM-SPSS-24 (Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp.) [14] program with a fixed block size. Descriptive data about patients characteristics including age, sex, occupation, physical activity, smoking, relevant medications, and BMI were recorded.

Operative technique

All eligible cases underwent one of two treatment techniques: conservative treatment (group B): intravenous cefotaxime (1 g every 12 h), amikacin (12–15 mg/kg/day every 12 h), and metronidazole (loading dose 15 mg/kg intravenous and then maintenance dose 7.5 mg/kg every 8 h) were given for 5 days duration, and laparoscopic surgery (group A), which was performed using the three-trocar technique. Endoscopic pretied loops were used for ligating the base of the appendix or large clips. All procedures were performed by experienced endoscopic surgeons, and a good peritoneal lavage with a large amount of saline was routinely performed in these cases; in addition, very strict intravenous and oral antibiotic protocols were applied for both groups A and B. Aspiration of all areas of the intraabdominal collection was performed followed by washing the peritoneal cavity with normal saline. An abdominal drain was left in the pelvis for all patients. Discharge was done on the fourth postoperative day, with oral antibiotics (cefixime+metronidazole) for another 5 days, except for two patients who underwent right hemicolectomy before discharge (stayed for 7 days), and another two patients who were readmitted for right hemicolectomy as their histopathology revealed cancer appendix (Figs 1–4). The guidelines for conversion to laparoscopy were increased white blood cell, fever (low-grade fever: 37.5–38.3°C), abdominal pain, and abdominal US.

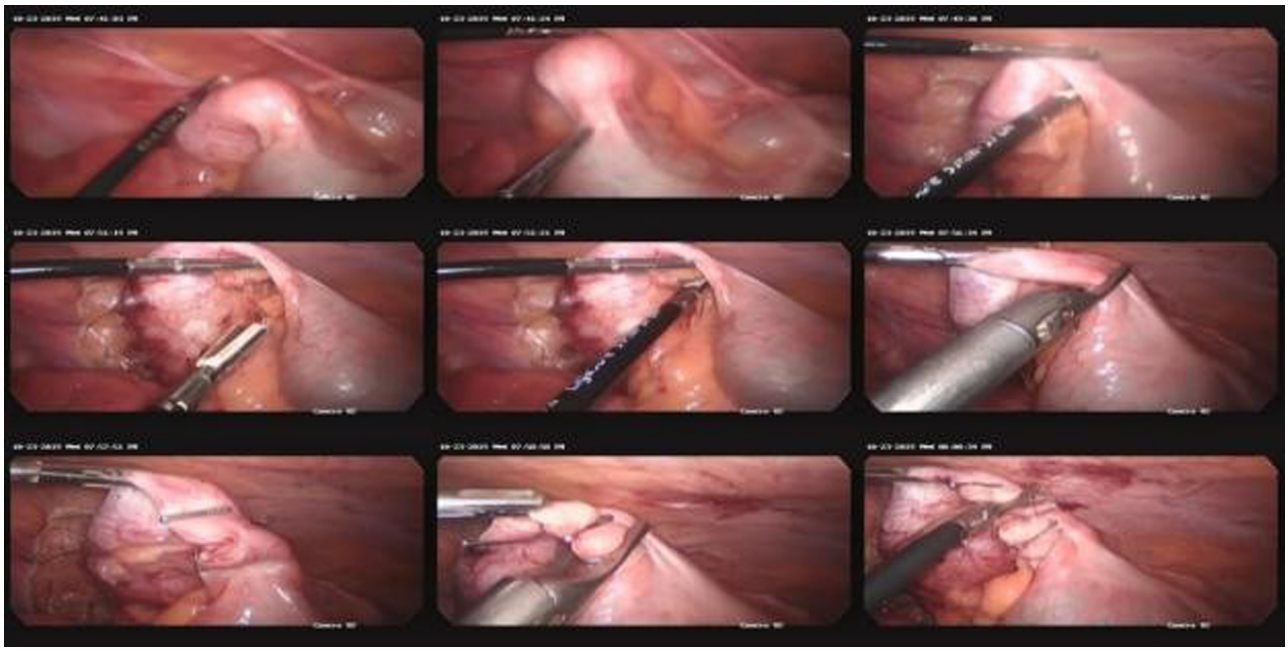
Data were verified, coded by the researcher, and analyzed using SPSS, version 24 [15]. Descriptive statistics, such as means, SDs, medians, and percentages were calculated. Tests of significance were as follows: χ^2/Fisher's exact test was used to compare the difference in distribution of frequencies among different groups. For continuous variables, independent t test analysis was carried out to compare the means. A P value less than 0.05 was considered significant. Approval for this study was

Figure 1



Flow chart of the studied sample.

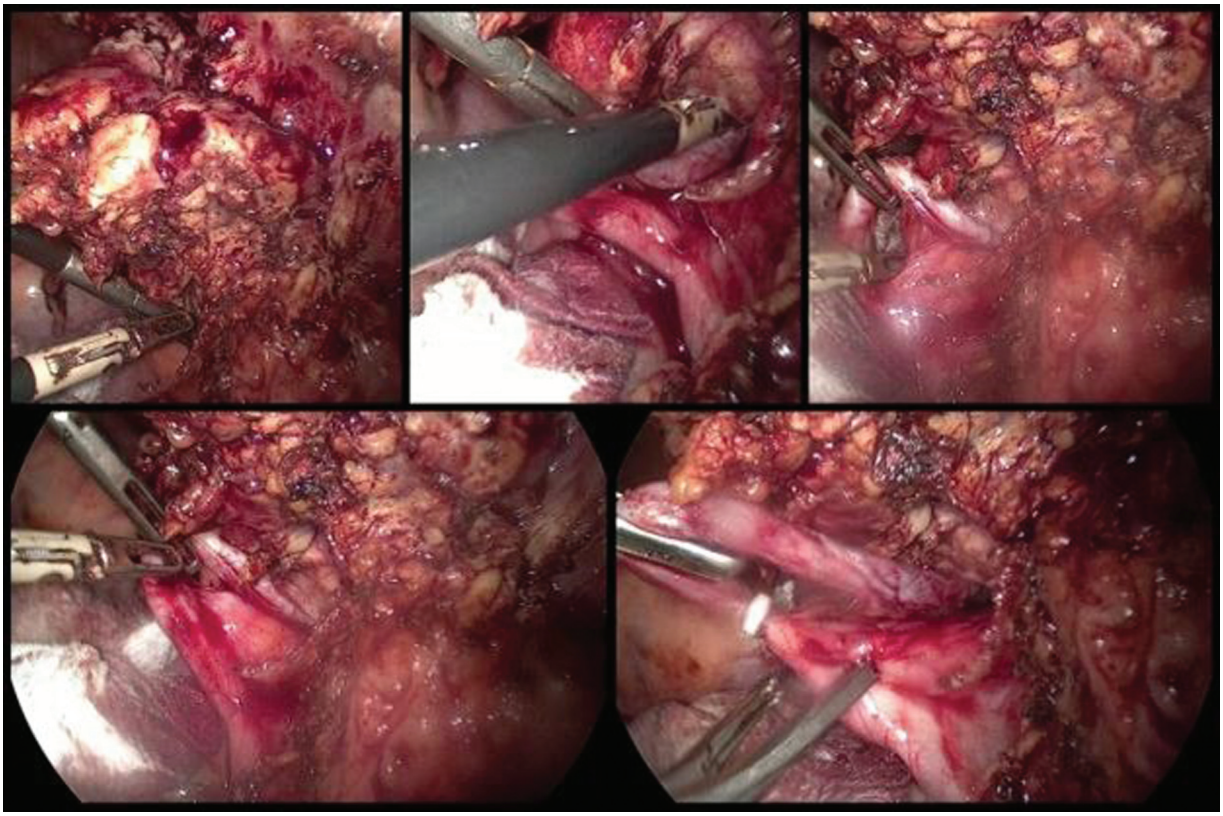
Figure 2



Appendicular mass.

obtained from Institutional Review Board (IRB) of Faculty of Medicine Sohag University before study execution. In addition, all participants received a written consent form. The informed consent was clear, and the merits and drawbacks of both treatment modalities were explained to all included patients with diagnosis of acute appendicitis with appendicular mass. Furthermore, participants' confidentiality and anonymity were assured by assigning each participant with a code number for the purpose of analysis only. The study was not based on any incentives or rewards for the participants, and it abided the guidelines of Helsinki Declaration [14] and the CONSORT guidelines.

Figure 3



Appendicular mass with clipping of appendix.

Figure 4

Appendicular mass with abscess formation.

Results

Patients' characteristics

In the laparoscopic group (group A), there were 30 patients. Approximately one-third was females and two-thirds were males. The mean age of the participants was 30 years (26–50 years). The average BMI was 30 (20–52). The average American Society of Anaesthesiologists (ASA) Physical Status Classification System (ASA) was 2.3 (1–4). Likewise, in the conservative group (group B), there were 30 patients: four (13.3%) males and 26 (86.7%) females. The mean age of participants of this group was 35 years (27–55 years) and the average BMI was 32 (21–71). The average ASA was 2.24 (–4) (Table 1).

Throughout the study period, 30 patients underwent laparoscopic appendectomy for appendicular mass and 30 patients for conservative treatment for 6 days. The duration of treatment started from the day of hospital admission and ranged from 3 to 5 days. If the patient on conservative treatment did not improve clinically, laparoscopic appendectomy was done for treatment.

In group A, besides the tenderness over the right iliac fossa; 10 (33.3%) patients were febrile upon admission, and 24 (80%) patients had leukocytosis (white blood cells count >14 000/mm^3). Moreover, 40% (n=12) of the cases had generalized collection. In addition, 40% (n=12) presented with abdominal distension, and about one-quarter (n=8) presented with vomiting (Table 2).

Moreover, in group A, all patients underwent laparoscopic appendectomy within 24 h of admission. The mean operative time was 95 min (45–140 min). The postoperative analgesic requirement was minimal. The average length of hospital stay was 6 days (6–9 days). During the operation, appendicular abscess was revealed in 20 (66.6%) patients, perforated appendix with fecalith in 24 (80%) patients, loculated pus in 22 (73.3%) patients, gangrenous appendix in 10 (33.3%) patients, pelvic collection in 14 (46.6%) patients, intestinal adhesion was found in 26 (86.6%) patients, adnexal mass in six (20%) patients (Table 3 and Fig. 4), and right hemicolectomy was done for four patients (two patients owing to severe cecal injury and two patients owing to carcinoma of the appendix (carcinoid tumours), as shown by postoperative histopathology. Within 1 week from discharge, 12 patients presented with mild lower abdominal pain; US was done and showed pelvic abscess (13.3%) and right iliac fossa abscess (26.6%), and they were treated with intravenous antibiotic (Table 4 and Figs. 5 and 6).

On the contrary, in group B (conservative group), 26 (86.6%) patients had leukocytosis above 14 000/mm^2,

Table 1 Patient characteristics of the studied cohort

	Group A (laparoscopy) (N=30) [n (%)]	Group B (conservative) (N=30) [n (%)]	P value
Age			
Range	26–50	27–57	0.027*
Mean±SD	30.41±5.7	35.27±10.3	
Sex			
Male	20 (66.7)	4 (13.3)	< 0.001**
Female	10 (33.3)	26 (86.7)	
BMI			
Range	26–51	21.2–71	0.457*
Mean±SD	30.41±5.7	32.35±12.9	
ASA			
Range	1–4	1–4	0.823***
Mean±SD	2.33±1.2	2.27±1.1	
Length of hospital stay			
Range	6–8	8–15	< 0.001*
Mean±SD	6.62±0.7	10.00±1.6	

ASA, American Society of Anaesthesiologists. aIndependent t test was used to compare the differences in means between groups. **χ^2 test was used to compare the frequency difference between groups. ***Mann–Whitney U test was used to compare the differences in medians between groups.

Table 2 Clinical picture of the studied cohort

	Group A (laparoscopy) (N=30) [n (%)]	Group B (conservative) (N=30) [n (%)]	P value
Temperature			
Yes	10 (33.3)	6 (20.0)	0.243*
No	20 (66.7)	24 (80.0)	
Leucocytes			
>14 000/mm^3	24 (80.0)	26 (86.7)	0.488*
<14 000/mm^3	6 (20.0)	4 (13.3)	
Peritonitis (generalized)			
Yes	12 (40.0)	0	<0.001**
No	18 (60.0)	30 (100.0)	
Abdominal distension			
Yes	12 (40.0)	12 (40.0)	1.000*
No	18 (60.0)	18 (60.0)	
Vomiting			
Yes	8 (26.7)	10 (33.3)	0.573*
No	22 (73.3)	20 (66.7)	

*χ^2 test was used to compare the frequency difference between groups. **Fisher's exact test was used to compare the frequency difference between groups.

and six (20%) patients had high-grade fever (above 39°C). Approximately two-thirds (n=18) of group B did not show any improvement on conservative approach and develop peritonitis, hence were subjected to laparoscopic management. Of the 18 patients, 16 completed laparoscopic, and two patients had difficult dissection and were subjected to open surgery by right para-median incision. Moreover, four patients of group B (subjected to laparoscopy) developed pelvic abscess, presented with pelvic pain and low-grade fever, and responded to intravenous antibiotic. The hospital stay was longer in this group (range, 6–12 days) (Table 2).

Table 5 shows the rate of improvement among both groups. There were higher rates of improvement among the laparoscopic group (26 cases, 86.7%) compared with the conservative one (12 cases, 40%), and this was statistically significant (P<0.001).

Table 3 Operative data in group A (laparoscopy)

	Group A (laparoscopy) (N=30) [n (%)]
Operative time (min)	
Mean±SD (range)	92.33±35.9 (45–140)
Intestinal injury	2 (6.7)
Appendicular abscess	20 (66.7)
Perforated appendix with fecalith	24 (80.0)
Loculated pus collection	22 (73.3)
Gangrenous appendix	10 (33.3)
Pelvic collection	14 (46.7)
Intestinal adhesion	26 (86.7)
Adnexal mass	6 (20.0)
Generalized peritoneal fluid collection	12 (40.0)

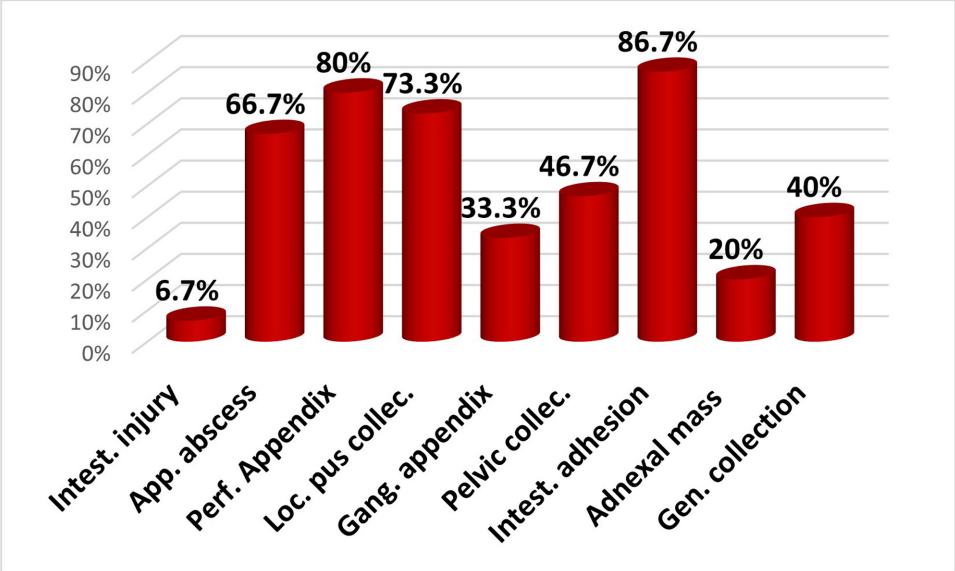
Discussion

Acute appendicitis is still one of the most common surgical emergencies, with an annual incidence rate of ~0.1% of cases [16]. The lifetime probability for the development of acute appendicitis is 8.6% in males and 6.7% in females. Up to 10% of these cases may develop appendicular mass [17]. Despite the aforementioned facts, there is no universal standard treatment of the appendicular mass with wide treatment options. Management options are emergency surgery, conservative management followed by interval surgery, and totally conservative management without interval surgery. Recently, laparoscopic appendectomy became the preferred treatment modality of acute appendicitis; however, its role in

Table 4 Operative and postoperative complications data in group A (laparoscopy)

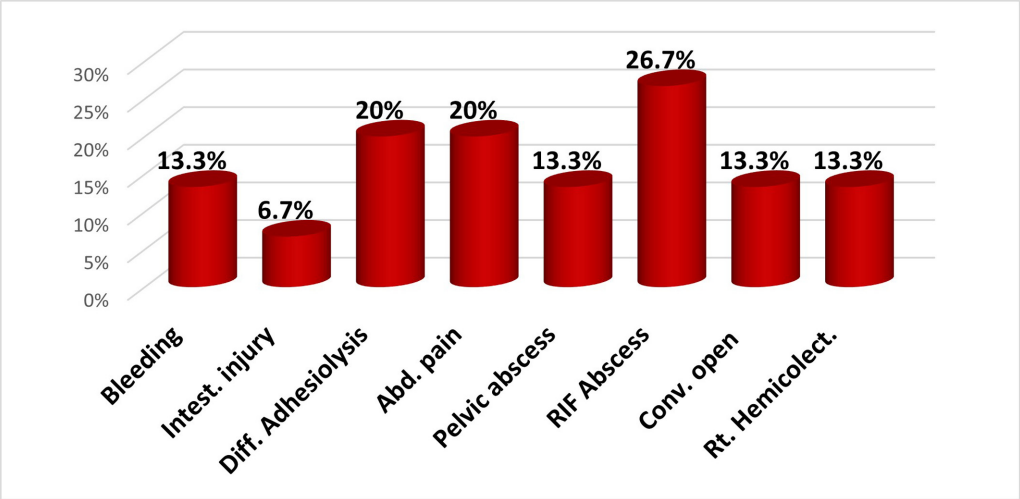
	Group A (laparoscopy group) (N=30) [n (%)]
Bleeding	4 (13.3)
Intestinal injury	2 (6.7)
Difficulty in adhesiolysis	6 (20.0)
Abdominal pain	6 (20.0)
Pelvic abscess	4 (13.3)
Right iliac fossa abscess	8 (26.7)
Subjected to open	4 (13.3)
Right hemicolectomy	4 (13.3)

Figure 5



Operative data in group A (laparoscopy).

Figure 6



Operative and postoperative complications data in group A (laparoscopy).

Table 5 Outcome of the studied cohort

	Group A (laparoscopy) (*N*=30) [*n* (%)]	Group B (conservative) (*N*=30) [*n* (%)]	*P* value
Outcome			
Improved	26 (86.7)	12 (40.0)	<0.001*
Not improved	4[a] (13.3)	18[b] (60.0)	

[a]Subjected to right hemicolectomy after diagnosis with cecal injury (*N*=2) and carcinoid tumor (*N*=2). [b]Subjected to laparoscopy treatment after failed conservative treatment. *Fisher's exact test was used to compare the frequency difference between groups.

management of complicated appendicitis is still debatable [7].

Patients will develop appendicular mass, especially with development of strong antibiotic. This usually occurs after 48–72 h of the first symptoms of acute appendicitis [18]. As a natural protective mechanism, the omentum and small bowel wrap around the inflamed appendix to isolate it from the rest of the abdominal cavity preventing spread of infection and forming the components of the mass. This usually becomes palpable in the right iliac fossa by the third day [17]. There is no universal standard or clear-cut guidelines in the management of the appendicular mass with extreme modalities of treatment [19].

Initial conservative approach followed by routine interval appendectomy 12 weeks later is the traditional and most practiced approach in the absence of abscess formation. It is trusted and favored widely all over the world because of its efficacy and safety [17,20,21]. Early appendectomy, once diagnosed with acute appendicitis, using either open or laparoscopic technique, is considered for the avoidance of misdiagnosis (or hidden other pathology), which is the more demanding operative interference when the conservative management fails; moreover, repeated admissions owing to the recurrent attacks of acute appendicitis ultimately require appendectomy after frequent admissions [22,23]. The time interval that shows the greatest risk of developing recurrent appendicitis after successful conservative management is during the first 6 months, and there is a minimal chance for developing the symptoms after 2 years [24,25].

Laparoscopic approach provides minimal invasive modality, with less hospital stay and rapid recovery. It is a growing and promising approach for management of appendicular mass, with less complication and shorter durations of treatment [6]. It is not easy to distinguish between an appendiceal mass and an appendiceal abscess preoperatively, and conservative management is not always successful [6,7]. Another disadvantage of the conservative management is the probability of misdiagnosis [11], with conditions like intussusception and carcinoma of cecum may be treated conservatively by mistake, in addition to considerable morbidity.

Early surgical intervention on the contrary has an edge of being curative in the index admission and ensures early return to work and higher rate of compliance. The

earlier belief that surgery is difficult in areas where the inflamed appendix is buried deep in the mass and the bowel loops are friable is no more a valid argument at present, because of an improvement in anesthesia, electro surgical unit, and antibiotics. Surgical problems such as appendix localization and bleeding can be treated with a magnified view of the laparoscope [16].

In a study done by Horwitz *et al.* [26], it was suggested to avoid the laparoscopic approach in complicated appendicitis because of the increased incidence of postoperative, intraabdominal abscesses. In this study, 16 patients (12 patients from group A and four patients from group B subjected to laparoscopic) (33.3%) developed complication, and they improved with medication. Many factors might have resulted in such complications, that is, not using drain and not washing well. Valla *et al*. [27] also recommended the open approach in complex cases with appendicular masses.

In contrast to our study, all cases with appendiceal mas were treated successfully with laparoscopic and open surgery. Our results were similar to others in terms of safety and feasibility. In a study by Richards *et al.* [28], they reported that laparoscopic appendectomy resulted in fewer complications, shorter hospital stays, and lower hospital cost than open appendectomy in patients with perforated appendicitis. Chen *et al.* [22] also found laparoscopic appendectomy to be possible and safe for treating complex appendicitis. Tirabassi *et al.* [29] reported a significant high conversion rate (36%) after laparoscopic operation for perforated appendicitis. Right hemicolectomy was performed in 4 patients in this study owing to severe cecal injury and cancer appendix.There are several advantages of the laparoscopic approach in complicated appendicitis such as the better visualisation of all abdominal cavity and the feasibility of complete peritoneal wash, which is difficult with a small incision. In open surgery, atypical localization of the appendix or inaccurate diagnosis may require an extension of the incision. The laparoscopic operation also allows patients to become freely movable and pain-free postoperatively, due to less trauma to the muscles and fascia [28]. Another advantage of laparoscopy may be due to the 30% lower rate of adhesions, which is a specifically common late complication, especially in children with perforated appendicitis [29].

However, the benefits of less postoperative pain and better cosmetic appearance were observed in these patients with initial conservative treatment followed by interval appendectomy 12 weeks later. Oschner in 1901 had proposed conservative management for treatment of appendicular mass [30]. This approach involved the administration of intravenous fluids and antibiotics while keeping the patients fasting for some period. The aim of this approach was to achieve complete resolution of the inflammatory mass and the improvement of symptoms in the patient before any surgical intervention. Some authors favor this approach because it is effective in most cases [30]. What is the justification of interval appendicectomy? It is first to prevent recurrence of acute appendicitis and second avoidance of misdiagnosing an alternative pathology such as malignancy [30].

Conclusion

Laparoscopic appendectomy is a feasible and safe approach in patients with early appendicular mass to reduce the probability of misdiagnoses, the length of hospital stay, and the need for hospital readmission. Laparoscopic appendectomy for mass is a feasible and safe approach with better outcome and shorter hospital stay compared with conservative modality.

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Conflicts of interest

There are no conflicts of interest.

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