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Complicated Appendicitis-The Changing Trend to Early Appendectomy Narrative: Review Article

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Abstract

The treatment of complicated appendicitis has always been conservative treatment followed by interval appendectomy, but with time the management has slowly evolved towards early appendectomy. As there is no consensus on its management, the treatment of this condition is usually decided by the treating surgeon. The emergence of laparoscopic appendectomy has seen a shift towards early appendectomy. We have conducted this review article to investigate the current management of complicated appendicitis looking into the role of conservative management, interval appendectomy and early appendectomy.

Keywords: *Complicated appendicitis; Appendicular mass; Interval appendectomy; Laparoscopic appendectomy; Early appendectomy*

Introduction

The definition of complicated appendicitis is also known to include appendicular mass and appendicular phlegmon, which involves the perforated appendix, omentum and surrounding bowel that forms a localized mass. Most General surgeons agree on the definition of complicated appendicitis that includes perforation of the appendix, intra-abdominal abscess, and purulent peritonitis. Controversy exists with regards to the management of complicated appendicitis, which can be divided into conservative treatment with intravenous antibiotics and fluids followed by interval appendectomy or immediate appendectomy [1]. The role of interval appendectomy after conservative treatment of appendicular mass has been questioned with it being indicated for patients who present with recurrent attacks of pain. Computed tomography and colonoscopy may be used to investigate older patients who have completed conservative treatment to not miss any other pathology [2]. The management of complicated can be divided into 1) Conservative treatment followed by interval appendectomy after 8 to 12 weeks.2) Conservative treatment without interval appendectomy.3) Immediate appendectomy. Conservative treatment involves the use of intravenous antibiotics and fluids [3]. As the management of complicated appendicitis is still controversial and hence, we have conducted this review article to investigate this. A literature review was performed on PubMed, the Cochrane database of systemic reviews and Google Scholar looking for original articles, observational studies, clinical trials, cohort studies, systemic reviews, meta-analysis, and clinical reviews from 1990 to 2023.The following keywords were used "complicated appendicitis"," Appendicular mass"," Appendicular Phlegmon"," Appendicular abscess "and "interval appendectomy". All articles were in the English language only and case reports, case studies, commentaries and tutorials were excluded (Figure 1).

Discussion

Conservative treatment of complicated appendicitis

Conservative treatment as described by Ochsner and Sheeren involves keeping the patient fasted, starting intravenous antibiotics, and analgesics. This is usually followed by an interval appendectomy in 8 to 12 weeks' time. This has been the

traditional management of appendicular mass [4]. The use of conservative treatment in the management of complicated appendicitis is safe and effective and it avoids injury to the intestines and surrounding structures. The need for interval appendectomy is often indicated to prevent recurrence [5].

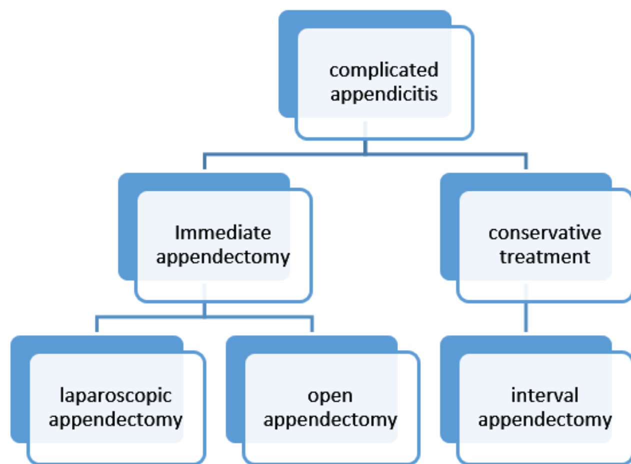

Figure 1: *Flowchart of the management of complicated appendicitis.*

The application of conservative treatment in the management of complicated appendicitis was associated with lower complication rate and a systemic review by Olsen et al, showed that the treatment failure rate was 8-15% when compared with immediate surgery. The drawback of this systemic review was that most of the studies were retrospective in nature [6]. A meta-analysis by simillis et al comparing conservative treatment versus appendectomy for complicated appendicitis showed that conservative treatment was associated with reduced complication and reoperation rates [7]. The duration of hospitalization, duration of antibiotic therapy, the overall complication rate and reoperation rates were important factors to decide the effectiveness of conservative treatment of complicated appendicitis [8].Conservative treatment may be a safer option in patients who present late to the hospital due to financial problems or ignorance on the part of the patient to self-medicate with analgesics. In these patients' immediate appendectomy may be associated with higher post-operative complication and risk of bower resection due to bowel injury [9]. Among the factors that may affect conservative treatment of complicated appendicitis is the size of the mass in the right iliac fossa and the duration of symptoms. Treatment failure is often seen in larger masses and prolonged duration of symptoms. In the pediatric patients below the age of 5 years, treatment failure is often due to the underdeveloped omentum and the earlier progression to appendicular abscess and generalized peritonitis [10]. Additional unfavorable outcomes for treatment of complicated appendicitis are presence of a mass in the right iliac fossa and the female gender. Patients living in rural areas as these may delay the presentation to the hospital for management [11]. A meta-analysis by andersson et al on the role of conservative management of complicated appendicitis showed that after successful treatment, the recurrence rate was 7.4% and they concluded that interval appendectomy was not indicated after conservative treatment [12]. For patients above the age of 40 may need follow up with computerized tomography or colonoscopy. Conservative management of complicated appendicitis in children is a safe and effective when compared to immediate appendectomy as increased blood loss and risk of injury to the neighboring bowel is higher [13]. A meta-analysis by fugazzola et al on early appendectomy vs conservative management in complicated appendicitis in children showed that children who underwent conservative treatment were found to have better complication rates and reduced readmission rates. Hence in children conservative treatment should be the treatment of choice in complicated appendicitis [14]. Pediatric patients with complicated appendicitis who are present with appendicular abscess may benefit from percutaneous drainage followed by conservative therapy. This therapy is associated with lower incidence of complications and faster recovery although patients may need to be followed up [15].

Table 1: *Studies that support conservative treatment of complicated appendicitis.*

Studies	Efficacy	Study type	N-numbers
Elaasdy et al	88%	Prospective study	169
Olsen et al	85%	Systemic review	3,772
Anderson et al	93%	Meta-analysis	59,488
Gillick et al	84.2%	Retrospective study	427
Fugazolla et al	90%	Meta-analysia	1,288

The use of percutaneous drainage followed by intravenous antibiotics in the management of complicated appendicitis with appendicular abscess is associated with a smaller need for interval appendectomy and a lower risk of recurrent attacks of right iliac fossa pain [16]. The common predictors of recurrent appendicitis after conservative management of complicated appendicitis include persist symptoms after completion of conservative treatment and resolution of symptoms that are longer than 6 days. The presence of appendicolith on ultrasonography is also an independent factor for recurrent attacks of appendicitis [17]. The presence of an appendicolith and not the location of the appendicolith affects the success rate of conservative management in the pediatric patient who presents with

complicated appendicitis. This may predict those patients who may need an emergency appendectomy if there is failure of conservative management [18]. These studies concluded that there is a role for conservative treatment in the management of complicated appendicitis, especially in the pediatric group. The wound infection rates and recurrence rates were low but as most of the studies were retrospective in nature, further prospective studies may be required to evaluate this (Table 1).

Interval appendectomy in complicated appendicitis

Upon completion of conservative treatment in complicated appendicitis, interval appendectomy is always performed in 8 to 12 weeks' time to prevent recurrence and to establish a diagnosis. Its indication has been questioned as the reported recurrence rates and morbidity are low and with interval appendectomy [19]. A study done in the mid-Trent region of the United Kingdom showed that 75% of general surgeons were likely to offer interval appendectomy after completion of conservative treatment where else specialist registrars were less likely to offer interval appendectomy to patients. This study showed the indication for interval appendectomy varies among various levels of surgeons and specialist trainees [20]. The South Coast appendicular mass management survey also confirmed the diverse nature of management of complicated appendicitis and a significant number of surgeons who do not perform interval appendectomy after conservative treatment [21]. The reason for performing an interval appendectomy after completion of conservative treatment for complicated appendicitis was to prevent recurrence and not to miss any other pathologies like malignancy. As these patients can be followed up with computerized tomography and colonoscopy, the indication of interval appendectomy is being questioned now [22]. As routine interval appendectomy is not required after completion of conservative treatment for complicated appendicitis, it is still being performed by surgeons as there is no clear recommendations on its indication and the judgement falls on the surgeon who is managing the patient [23]. A systemic review by Darwazeh et al looked at the indication of interval appendectomy after completion of conservative treatment. With the reported recurrence rate ranging from 6 to 20 %, performing an interval appendectomy does not offer any additional benefit and is associated with increased cost and morbidity. Most patients can be followed up with imaging like computerized tomography and colonoscopy [24]. Interval appendectomy is now offered to selected patients who present with recurrent symptoms of abdominal pain after completion of conservative treatment. It should not be a routine practice in the management of complicated appendicitis [25]. In the pediatric patients who present with complicated appendicitis, the risk of perforation is about 20% and interval appendectomy may be indicated in these patients to prevent recurrence and subsequent readmission [26]. The pathological examination of the specimen following interval appendectomy was done by fouad et al, who conducted a retrospective study. 51% of the specimens showed chronically inflamed appendix, 34.9% showed acute on chronic inflammation, 12.8% acutely inflamed appendix, 16.8% fecolith and 1.3% acute fibromuscular tissue. This study showed the importance of interval appendectomy in children [27]. Also examined the histopathology of the appendix specimen of patients who underwent interval appendectomy and the results showed that all specimens had various grades of inflammation and there were no neoplasms [28]. These studies concluded that interval appendectomy need not be routinely done after completion of conservative treatment. As patients can be followed up with computerized tomography and colonoscopy, Interval appendectomy is only indicated for patients who present with recurrent symptoms (Table 2).

Table 2: *Studies that support interval appendectomy following conservative treatment.*

Studies	year	N-numbers	Study type	Complication rate
Gillick et al	2001	427	Systemic review	2.3%
Gonzales et al	2003	41	Case-control study	N/A
Darwazeh et al	2016	543	Systemic review	10.4%
Weiner et al	1989	104	Retrospective study	5.9%
Fouad et al	2017	149	Observational study	6%

Early appendectomy and Laparoscopic appendectomy

Early appendectomy has been advocated in the management of complicated appendicitis as it reduces the need of a second admission and misdiagnosis of other conditions like carcinoma of the caecum. Early appendectomy is also associated with reduced wound infection rate and better recovery. It is also safe due to significant improvements in surgical techniques and better post-operative care [29-32]. A meta-analysis by Gavrillidis et al showed the shift in management of complicated appendicitis from conservative treatment to early appendectomy due to better diagnostic tools and significantly better surgical expertise and experience with a trend towards laparoscopic surgery [33]. The trend of early appendectomy has been slowly shifting from open appendectomy towards laparoscopic appendectomy. The advantage of laparoscopic surgery is better visualization of the abdomen and easier mobilization of the organs and better access for peritoneal lavage. As the skin incision is smaller, it is associated with decreased post-operative pain and faster

mobilization. It is also associated with reduced hospital stay and a faster discharge [34-37]. Early appendectomy is also advocated in the management of complicated appendicitis in children as it is associated with better recovery, reduced wound infection rates, and reduced readmission rates when compared to conservative treatment. Laparoscopic appendectomy has also been advocated in the management of complicated appendicitis in the pediatric age group. The advantages are reduced wound infection rates, earlier recovery and reduced hospital stay [38-40]. Laparoscopic appendectomy was found to be feasible in the management of complicated appendicitis in childrenas it associated with reduced wound infection rate and intra-abdominal abscess formation when compared to open appendectomy [41]. An advantage of laparoscopic appendectomy in the management of complicated appendicitis is the reduced rate of wound infection when compared to open appendectomy.

Table 3: *Studies that favor early laparoscopic appendectomy for complicated appendicitis.*

Studies	Study type	N-numbers	Wound infection rate	Year of study
Ali et al	Randomized control trial	150	8%	2014
Prasad et al	Retrospective study	100	0%	2017
Garg et al	Comparative study	49	8.2%	2008
YM lin et al	Retrospective study	94	1.1%	2009
Gavrillidis et al	Systemic review	810	4.6%	2018

This can lead to reduced hospital stay and a faster discharge of the patient [42]. As we enter the laparoscopic era, the role of laparoscopic appendectomy in the management of complicated appendicitis is becoming popular due to better access to the abdomen and reduced post-operative complications, better analgesia and reduced hospital stay. The mean blood loss was also reduced in patients who underwent laparoscopic appendectomy for complicated appendicitis. The drawback of these studies was that they were retrospective in nature and sample size were small [43-45]. Performed a systemic review and meta-analysis on the feasibility of laparoscopic appendectomy for complicated appendicitis.16 studies were identified which included 2 randomized control trials and 14 retrospective cohort studies. The results showed that laparoscopic appendectomy was associated with reduced wound infection rate, shorter hospital stay and faster oral intake, but the operative time was longer. This showed that laparoscopic appendectomy was feasible in the management of complicated appendicitis. The limitations of this study were that most of the studies were retrospective in nature [46].These studies show that laparoscopic appendectomy is associated with fewer complications, decreased wound infection rates, and reduced hospital stay. With more training in laparoscopic surgery, more surgeons will be able to perform this procedure. The limitations of the studies were that the majority were retrospective studies, and the sample size was small. Further randomized control trials may be needed to evaluate this (Table 3).

Conclusion

This review article concludes that the management of complicated appendicitis is moving towards early appendectomy and laparoscopic appendectomy being the operation of choice. The World Society of Emergency Surgeons in their guidelines have suggested early appendectomy via laparoscopic method. But in countries where laparoscopic services are not available, conservative treatment is an accepted treatment option. The role of interval appendectomy is only reserved for patients who present with recurrent symptoms. The absence of proper guidelines makes management of complicated appendicitis decided by the treating surgeon. The management of complicated should be early or immediate appendectomy with conservative treatment being reserved for patients with comorbidities or if the expertise is not available. Conservative treatment of complicated appendicitis may still be relevant as performing early appendectomy may require training and as appendectomy is usually performed by surgical registrars and junior surgeons and the risk of complications are slightly higher. Laparoscopic appendectomy was performed by experienced surgeons in all the studies that were reviewed. Hence proper training is required for surgeons who want to perform early appendectomy for patients with complicated appendicitis.

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