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Complicated Appendicitis-An Update : A Narrative Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Complicated Appendicitis is defined as perforated appendicitis with abscess or mass formation. Its diagnosis and management have been controversial with no consensus on its definition and treatment algorithm. The treatment was initially conservative management, but the current trend is immediate appendectomy by the laparoscopic method. Other areas of controversy include the need for interval appendectomy and the role of percutaneous drainage of appendicular abscess. We have conducted this review article to investigate the definition, diagnosis, and treatment of complicated appendicitis.

Keywords: Complicated appendicitis; appendicular mass; appendicular abscess; appendectomy; laparoscopic appendectomy.

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1. INTRODUCTION

Acute appendicitis is a common abdominal emergency with a life-time risk of 8% and it is divided into uncomplicated and complicated appendicitis. Uncomplicated appendicitis usually means inflammation of the appendix and complicated appendicitis being associated with inflammation of the appendix with phlegmon, perforation with or without abscess formation [1].

The European Association of Emergency Surgeons defined complicated appendicitis as a gangrenous inflamed appendix with or without perforation, intra-abdominal abscess, peri-appendicular contained phlegmon or purulent free fluid [2].

The treatment of complicated can be divided into conservative treatment with intravenous antibiotics followed by an interval appendectomy in eight weeks' time, conservative treatment alone without interval appendectomy and immediate appendectomy. The trend in treatment of complicated appendicitis has been moving towards immediate appendectomy since the introduction of laparoscopic appendectomy [3-6].

Patients with complicated appendicitis who present with an appendicular abscess can be management with intravenous antibiotics and percutaneous drainage of the abscess being performed for abscess that is more than 5cm in size [7].

As there is no current consensus in the management of complicated appendicitis, we have conducted this review article looking into the definition, diagnosis, and management of complicated appendicitis. We conducted a literature review using PUBMED, the Cochrane database of systemic reviews, Google scholar and semantic scholar looking for randomized control trials, non-randomized trials, observational and cohort studies, clinical reviews, systemic reviews, and meta-analysis from 1995 to 2023.The following keywords were used, "complicated appendicitis", "appendicular mass", "appendicular abscess", "appendectomy "and "laparoscopic appendectomy". All articles were in English, and all articles were assessed by manual cross referencing of the literature. Commentaries, case reports and editorials were excluded from this review. Adult and pediatric patients were included in this study and pregnant patients with acute appendicitis were excluded.

2. DISCUSSION

2.1 Definition of Complicated Appendicitis

Complicated appendicitis is defined as perforation of the appendix, with abscess formation or mass formation. The mass is an inflammatory one consisting of the appendix, caecum, terminal ileum, and omentum [8].

The Italian polispecialistic society of young surgeons defined complicated appendicitis as presence of any of the following intraoperative findings, visible perforation, abscess, diffuse fibrin purulent exudate or extraluminal fecalith [9].

Mariage et al defined complicated appendicitis as perforated appendicitis, peri appendicular abscess or peritonitis, defined as acute inflammation of the peritoneum secondary to infection of the appendix. Moris et al defined complicated appendicitis as appendiceal rupture with subsequent abscess or phlegmon formation [10-12].

Based on the studies there is still no consensus on the definition of complicated appendicitis, with perforation of the appendix, with mass formation, with or without abscess formation being the most common definition.

2.2 Diagnosis of Complicated Appendicitis

Laboratory investigations like total white cell count, C-reactive protein, serum bilirubin and neutrophil lymphocyte ratio can be used to aid in the diagnosis of complicated appendicitis, but it must be used with clinical examination due to its low sensitivity [13].

Elevated white cell count, and C-reactive protein are important predictors for complicated appendicitis, but both these markers have low sensitivity and specificity. These serum markers can be used to differentiate uncomplicated from complicated appendicitis [14,15].

The use of imaging modalities like ultrasound and computerized tomography have shown varied results, Bolmers et al in his prospective observational study showed that the use of ultrasound in diagnosing complicated appendicitis showed a sensitivity of 35% and a specificity of 93%, while computerized

tomography showed a sensitivity of 45% and a specificity of 88%. This study showed that imaging modalities were poor in diagnosing complicated appendicitis [16].

Gaskill et al retrospectively evaluated the use of computerized tomography in diagnosing complicated appendicitis and the sensitivity was 7% with a specificity of 89%. This study showed that the diagnostic accuracy of computerized tomography from differentiating complicated from uncomplicated appendicitis was poor [17].

Computerized tomography was useful in detecting fat stranding and free fluid in the abdomen and these features are seen in complicated appendicitis. This highlights the importance of computerized tomography in diagnosing complicated appendicitis [18].

Bom et al conducted a systemic review and meta-analysis to discriminate complicated appendicitis by ultrasound, computerized tomography, and magnetic resonance imaging. The results of this study showed that for computerized tomography the sensitivity was 78%, specificity 91%, positive predictive value 74% and negative predictive value 93%. There was lack of data for ultrasound and magnetic resonance imaging, and this meta-analysis showed that these imaging modalities had limitations in diagnosing complicated appendicitis [19].

The conclusion of these studies shows that the diagnosis of complicated appendicitis includes both clinical examination and imaging.

2.3 Conservative Treatment of Complicated Appendicitis

The conservative treatment of complicated appendicitis includes starting the patient on intravenous antibiotics and analgesics, while monitoring the vital signs. This was traditionally followed by an interval appendectomy in 8 weeks' time. This was associated with reduced complications and reoperation rates [20-25].

A meta-analysis by Simillis et al, concluded that conservative treatment of complicated appendicitis was associated with reduced wound infection rates, decreased intra-abdominal abscess, pelvic abscess, and bowel obstruction. This study concluded that conservative treatment was a safe option in the management of complicated appendicitis [26].

A meta-analysis by Fugazola et al comparing conservative treatment and immediate surgery on complicated appendicitis in children concluded that conservative treatment was associated with better complication rates and readmission rates. This meta-analysis concluded that conservative treatment was a viable and safe treatment option in the treatment of complicated appendicitis [27].

Anderson et al also performed a meta-analysis on the management of complicated appendicitis and concluded that conservative management was associated with lower complication, but routine interval appendectomy need not be performed due to the low risk of recurrence [28].

A meta-analysis by van Amstel et al on the management of complicated appendicitis in children showed that conservative treatment with intravenous antibiotics should be the first line of management with appendectomy reserved for patients who do not respond to conservative treatment [29].

The conclusion from these studies show that conservative treatment is a viable treatment option for patients with complicated appendicitis with appendectomy being reserved for recurrent attacks. It was associated with reduced complications and mortality.

Table 1. The meta-analysis on recurrence rates after conservative treatment of complicated appendicitis

Study	Study type	N=numbers	Recurrence rate
Anderson et al [28]	Meta-analysis	59,448	7.4%
Fugazola et al [27]	Meta-analysis	1288	15.4%
Van Amstel et al(2020)	Meta-analysis	1355	34%

2.4 The Role of Interval Appendectomy

Traditionally interval appendectomy was performed after conservative treatment, but its role was questioned due to the low recurrence rates. A systemic review of the literature by Darwazeh et al concluded that interval appendectomy can be omitted as it provides minimal benefit and is associated with increased cost and morbidity [30].

Retrospective studies by Willemsen et al and Tekin et al also concluded that interval

appendectomy need not be routinely performed after completion of conservative treatment as patients who were at risk of malignancy can be followed up with computerized tomography or colonoscopy [31,32].

A Review by Perez et al on the need of interval appendectomy after conservative treatment for complicated appendicitis concluded that interval appendectomy should be considered for patients who present with recurrent symptoms and those who have fecalith on imaging. This was also supported by a review by Corfield who concluded that due to the low recurrence rate interval appendectomy need not be routinely performed [33,34].

The conclusion from these studies show that routine interval appendectomy need not be routinely performed, and it is reserved for patients with recurrent attacks.

2.5 Percutaneous Drainage of Appendicular Abscess

The use of conservative treatment followed by percutaneous drainage of appendicular abscess in patients with complicated appendicitis was studied by Lasson et al.24 patients underwent percutaneous drainage of abscess and there was recurrence in 4 patients, and they concluded that percutaneous drainage of abscess was effective in large abscess and can be combined with intravenous antibiotics in the treatment of complicated appendicitis [35].

Percutaneous drainage of appendicular abscess was found to be effective in the management of complicated appendicitis in pediatric patients. A study by Cheng Luo et al showed that percutaneous drainage in children with complicated appendicitis with appendicular abscess was associated with reduced incidence of recurrence and the need for interval appendectomy [36].

A retrospective study by roach et al on the use of intravenous antibiotics and percutaneous drainage of abscess in children who presented with complicated appendicitis was associated with reduced complications and readmissions due to recurrence [37].

A prospective study by Zerem et al comparing percutaneous drainage with antibiotics with antibiotics alone in the treatment of complicated appendicitis showed a lower recurrence rate and reduced need for interval appendectomy. This study highlighted the effectiveness of percutaneous drainage of an appendicular abscess [38].

Factors that affect percutaneous drainage include the onset, durations of symptoms and if the drainage is performed by ultrasound or computerized tomography [39]..

The conclusion from these studies show that percutaneous drainage is a viable treatment option, but the size of the abscess influences the outcome.

2.6 Immediate Appendectomy in the Management of Complicated Appendicitis

There has been a shift in the management of complicated appendicitis with immediate appendectomy being advocated as the primary treatment of choice to treat this condition and prevent complications like recurrence [40]. A study by Deelder et al noted the high complication rates with conservative treatment and immediate appendectomy was able to provide a definitive diagnosis [41].

Traditionally open appendectomy has been the treatment of choice, but the introduction of laparoscopic appendectomy has seen a trend towards this form of management. Laparoscopic appendectomy was associated with a shorter operative time, lower incidence of wound infection, reduced analgesia usage and reduced hospital stay [42-45].

Laparoscopic appendectomy was compared with open appendectomy, and it was safe with reduced wound infection rates and intra-abdominal abscess formation that was comparable to conventional appendectomy and not influenced by the laparoscopic technique. Laparoscopic appendectomy has been shown to reduce the morbidity, mortality, length of hospital stays and cost [46,47].

A systemic review and meta-analysis comparing laparoscopic versus open appendectomy in adults with complicated appendicitis concluded that laparoscopic appendectomy was associated with reduced risk of surgical site infection and with no additional risk of intra-abdominal abscess formation. These findings were also confirmed by Athanasiou et al in their systemic review and meta-analysis of laparoscopic versus open

Table 2. Summary of the studies that compared wound infection rates between laparoscopic and open appendectomy for complicated appendicitis

Study	Study type	N=numbers	Wound infection rate-laparoscopic appendectomy	Wound infection rate-open appendectomy
K.You et al(2004)	Retrospective study	244	0.6%	10%
Taguchi et al [51]	Randomized control trial	81	33.3%	25.6%
Athanasiou et al [49]	Meta-analysis/systemic review	4439	6.7%	17.7%
Talha et al [50]	Randomized control trial	126	8.3%	22.7%

appendectomy in adults with complicated appendicitis [48,49].

Randomized clinical trials were conducted to compare laparoscopic versus open appendectomy for complicated appendicitis and the results showed that laparoscopic appendectomy was associated with reduced wound infection rates, shorter hospital stays and reduced analgesia usage [50,51].

The risk of intra-abdominal abscess formation following laparoscopic appendectomy for complicated appendicitis is the same as for open appendectomy. This was observed in the meta-analysis comparing laparoscopic versus open appendectomy in pediatric patients with complicated appendicitis [52].

The current morbidity of intra-abdominal abscess formation following laparoscopic appendectomy for complicated appendicitis has seen a decreasing trend, which has seen a shift towards immediate appendectomy in the management of complicated appendicitis [53,54].

The outcome from all these studies show that immediate laparoscopic appendectomy is the current first line treatment for complicated appendicitis.

3. CONCLUSION

The treatment of complicated appendicitis has seen a shift from conservative management towards immediate appendectomy. Laparoscopic appendectomy should be the surgery of choice if the expertise is available. Interval appendectomy should not be done as a routine and older patients should be followed up with imaging like computerized tomography and colonoscopy. For patients who present with intra-abdominal abscess there is a role for percutaneous drainage of the abscess.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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