

# EARLY OPERATIVE MANAGEMENT OF COMPLICATED APPENDICITIS IS ASSOCIATED WITH IMPROVED SURGICAL OUTCOMES IN ADULTS: A COMPREHENSIVE SYSTEMATIC REVIEW

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## ABSTRACT

**Background:** The management of appendicitis has been surgical over the years with high significant efficacy and low complication rate, and is recommended for the treatment of appendicitis in those cases in which there is a dilatation of more than 13 mm of the appendix, mass effect or presence of appendicolith in imaging. However, recent evidence from different series has proposed medical management for this condition in specific high surgical risk populations.

**The aim:** The aim of this study to show about early operative management of complicated appendicitis is associated with improved surgical outcomes in adults.

**Methods:** By the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. This search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, SagePub, and Google Scholar were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

**Result:** In the PubMed database, the results of our search get 23 articles, whereas the results of our search on SagePub get 151 articles, on Google Scholar 2840 articles. Records remove before screening are 2110, so we get 904 articles for screening. After we screened based on record exclude, we compiled a total of 10 papers. We included five research that met the criteria.

**Conclusion:** Laparoscopic appendectomy is becoming the gold standard for the treatment of appendicitis. However, the advantages of the innovations in minimally invasive and endoscopic surgery are unlikely to render formal open appendectomy obsolete. Nonoperative management with antibiotics may suffice in selected cases with uncomplicated appendicitis.

**Keyword:** Appendicitis, management, surgery, complications.

## INTRODUCTION

Acute appendicitis is one of the most common surgical emergencies encountered in the ED. This condition may be associated with complications and significant rise in morbidity and even mortality if diagnosis and treatment are delayed. Since the first appendectomy in 1883, early appendectomy has been advocated for acute appendicitis. The course of conservative therapy of acute appendicitis with antibiotics has been accepted in the pediatric population. This concept of conservative therapy challenged the historical paradigm of emergent appendectomy in the adult population.<sup>1</sup>

The duration of the inflammation of the appendix is related to the risk of perforation. Time periods between the onset of symptoms, medical assessment, and treatment are important. Previous studies revealed that in-hospital delay increases the risk of perforation in adults with appendicitis. Perforation was associated with a higher complication rate and increased length of hospital stay. On the other hand, in recent studies, delayed appendectomy, from 12 to 36 h from the symptom onset, was acceptable.<sup>1</sup>

Appendicitis has a more rapid course in the elderly because of atherosclerosis, gangrene, and perforation are common. The perforation rate of 25% in patients with a history of pain of less than 24 h is not much lower than the 35% rate of perforation in patients with a history of over 48 h. These may indicate that uncomplicated and complicated appendicitis are distinct diseases. An alternative outcome is that the appendix becomes surrounded by a mass of omentum which walls the inflammatory process and prevents inflammation from spreading to the abdominal cavity (appendix mass), yet the resolution of the condition is delayed. If the appendix becomes walled off by the omentum but has perforated, an abscess will develop localized to the periappendiceal region in the right paracolic gutter or the subcecal area of the pelvis. However, there is no evidence to indicate the proportion of patients likely to develop diffuse sepsis because the antibiotic treatment alters the pattern of disease by replacing the risks of perforation with the lesser risk associated with surgery.<sup>2</sup>

Several older studies, including two meta-analyses of complicated appendicitis, have shown that immediate operative management is associated with higher rates of complications. On the other hand, a small randomized trial in adults with an abscess demonstrated that immediate laparoscopic surgery was associated with fewer readmissions and CT scans, as well as fewer complications and re-interventions. According to the findings of this study, early surgical care of complex appendicitis is associated with improved surgical outcomes in adults. This association was shown to be significant.<sup>3</sup>

## METHODS

### Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

### Criteria for Eligibility

For the purpose of this literature review, we compare and contrast early operative management of complicated appendicitis is associated with improved surgical outcomes in adults. It is possible to accomplish this by researching or investigating early operative management of complicated appendicitis is associated with improved surgical outcomes in adults. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about early operative management of complicated appendicitis is associated with improved surgical outcomes in adults. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

### Search Strategy

We used "early operative management of complicated appendicitis is associated with improved surgical outcomes in adults." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: *("Appendicitis"[MeSH Subheading] OR "Diagnosed of appendicitis"[All Fields] OR "Management of appendicitis" [All Fields]) AND ("Complications of appendicitis"[All Fields] OR "Surgical of appendicitis" [All Fields]) AND ("Prognosis of appendicitis"[All Fields]) OR ("Complications of surgical of appendicitis" [All Fields]))* used in searching the literature.

### Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to

the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

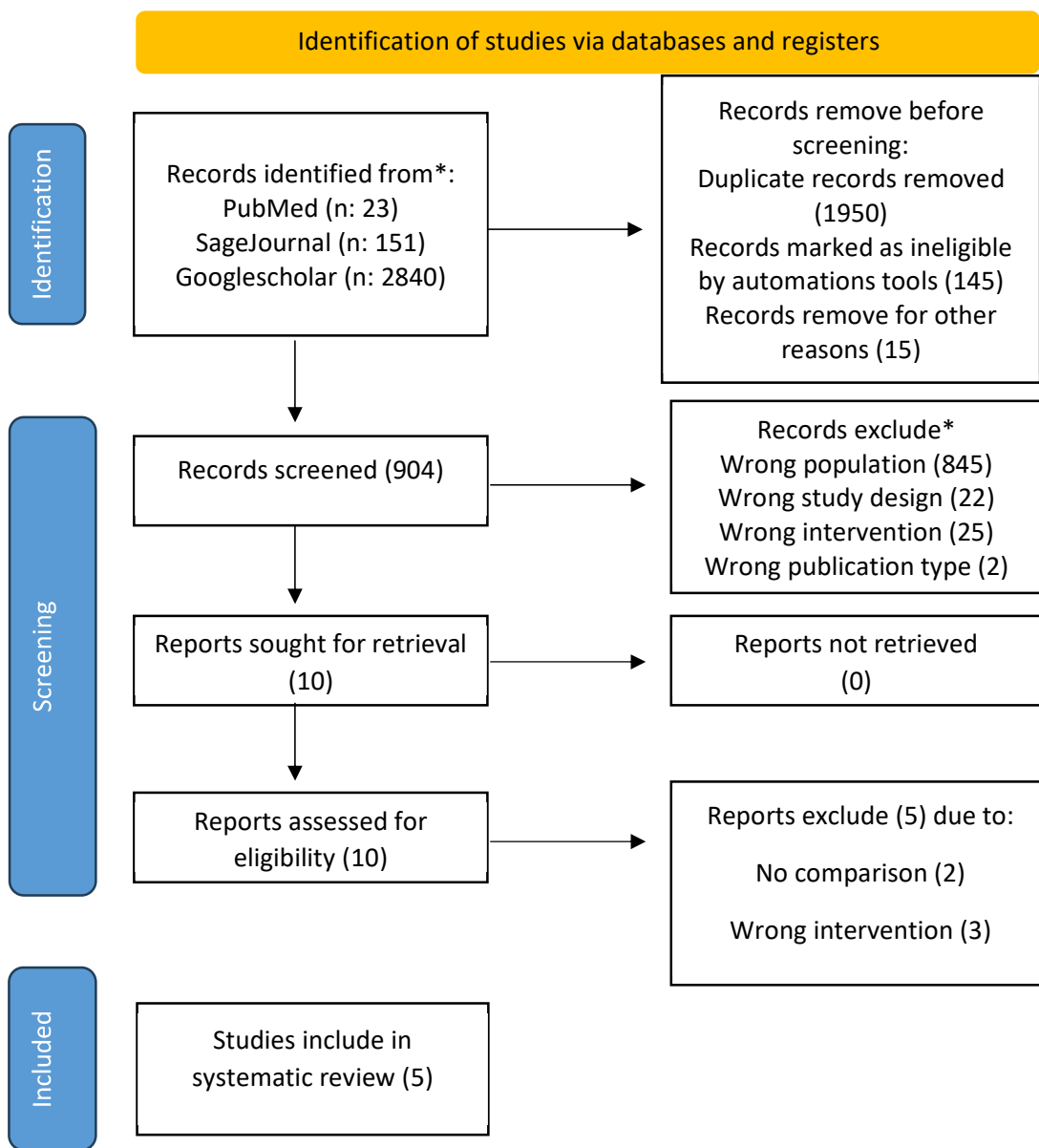


Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

### Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised

in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

**RESULT**

From the PubMed database, the results of our search get 23 articles, whereas the results of our search on SagePub get 151 articles, on Google Scholar 2840 articles. Records remove before screening are 2110, so we get 904 articles for screening. After we screened based on record exclude, we compiled a total of 10 papers. We included five research that met the criteria.

Balogun, OS et al (2019)<sup>4</sup> showed perforated appendicitis is a common complication of acute appendicitis occurring in a young population in our environment. Significant risk factors for appendiceal perforation in this study were first episode of abdominal pain and male sex. A history of recurrent acute appendicitis predating perforation was found in minority of our patients. In addition, previous abdominal surgery and comorbid medical conditions were less contributing factors in our patients. SSI was the most common complication after surgery. Routine use of intraperitoneal drain had little effect on the incidence of pelvic abscess. The overall prognosis is good with early surgical intervention.

Kim, JY et al (2019)<sup>5</sup> showed the pEIS group showed a lower rate of ileo-cecectomy or right hemicolectomy, a tendency of lower rate of overall complication, a lower rate of wound infection, and a shorter postoperative hospital stay, although total hospital stay was longer and total cost was higher in the pEIS group. Failure of EIS increased the risk of postoperative complications. High ASA physical status classification (III) and CT finding of grades Ib and II/II were risk factors for failure of EIS. EIS can be a useful surgical option in adults with complicated appendicitis, especially for patients with low ASA physical status classification (I or II) and initial CT finding of grade Ia. We recommend that patients should be fully informed that EIS is beneficial in all CT grades, but the higher the grade, the greater the likelihood of failure of EIS.

**Table 1. The literature include in this study**

Author	Origin	Method	Sample Size	Result
Balogun, OS et al., 2019 <sup>4</sup>	Nigeria	We conducted a seven-year retrospective review of consecutive adult patients who had surgery for perforated appendicitis in our centre.	224	The perforation rate in the study was 28.5%. The peak age of presentation was between 21-30 years. Forty-two (71.1%) of the patients under study were males. Only 3 (5.1%) of the cohorts had history of recurrent abdominal pain. Majority of the patients were in the American Society of Anesthesiologists (ASA) II (44.1%) and III (42.4%) categories. Surgical site infections (SSI) (18.6%), wound dehiscence (15.2%) and pelvic abscess (13.5%) were the most common complications. The incidence of SSI was found to correlate with male gender, ( $P = 0.041$ ), co-morbidity ( $P = 0.037$ ) and ASA score (0.03) at 95% confidence interval. Routine use of intraperitoneal drain after surgery for perforated appendicitis did not appear to reduce the incidence of pelvic abscess. No mortality in the studied population.
Kim, JY et al., 2019 <sup>5</sup>	Korea	A prospectively maintained database of complicated appendicitis was queried. Elective interval surgery (EIS) group and	6074	The propensity score-matched EIS group had a lower chance to underwent ileo-cecectomy or right hemicolectomy (1.5% vs. 6.9%, $P = 0.031$ ), a tendency of lower rate of postoperative complication (6.9% vs. 13.7%, $P = 0.067$ ), a

		early surgery (ES) were matched with propensity score and marked with a prefix 'p.' Patient characteristics and surgical outcomes were compared.		lower rate of wound infection (1.5% vs. 8.4%, P = 0.010), and shorter postoperative hospital stay (3.72 days vs. 5.82 days, P < 0.001) than the propensity score-matched ES group. Multivariate analysis showed that delayed surgery for more than 48 hours or urgent surgery due to failure of EIS and open conversion were independent risk factors for postoperative complications (P = 0.001 and P = 0.025, respectively). In subgroup analysis, high American Society of Anesthesiologists physical status classification and distant abscess or generalized ascites in initial CT increased the risk of failure of EIS.
<b>Yamada, T et al., 2021<sup>6</sup></b>	Japan	This retrospective cohort study included adult patients who underwent appendectomy and who were registered in the National Clinical Database (NCD) from 2014 to 2016.	109256	We included 109 256 patients in the study: 14 798 CA, 86 876 UA, and 7582 EA patients. Compared with the UA group, the rates of all morbidity, serious morbidity, and mortality were significantly higher in the CA group. All morbidity, serious morbidity, and mortality rates were significantly lower in the EA group than in the other two groups.
<b>Alotaibi, AM et al., 2022<sup>7</sup></b>	Saudi Arabia	This is a single-center retrospective review of patients who had undergone an appendectomy between 2016 and 2018. The patients were divided into 2 groups: complicated appendicitis versus simple appendicitis.	449	Of 449 patients who underwent appendectomy, 60 (13.4%) had complicated appendicitis. The complicated appendicitis was significantly associated with increased age, pain duration, neutrophilia, high C-reactive protein, fecalith presence, and free fluid. The incidence rate of surgical site infection was 5.8% (identified in 26 patients). Compared to simple appendicitis, complicated appendicitis was associated more with wound infection (1.8% vs 10%, respectively, P = .001), postoperative collection (1.2% vs 11.6%, respectively, P = .001), and readmission within 30 days (2.3% vs 13.4%, respectively, P = .001). By multivariate analysis, factors associated more with increased hospitalization were pain duration (hazard ratio = 2.37, 95% confidence interval = 1.09–5.16, P = .029),

				operative time (hazard ratio = 2.09, 95% confidence interval = 1.04–4.21, P = .038), and complicated appendicitis (hazard ratio = 6.61, 95% confidence interval = 2.67–14.21, P = .001).
<b>Symeonidis, NG et al., 2022<sup>8</sup></b>	Yunani	We retrospectively reviewed the medical files of adult patients operated on for acute appendicitis over a 6-year period.	129	A total of 129 patients were identified and included in this study. Complicated appendicitis was found more frequently in female patients and older patients. Hyponatremia was found significantly more frequently in patients with complicated appendicitis ( $p < 0.001$ ) and also in patients with perforation than without perforation ( $p=0.047$ ).

Yamada, T et al (2021)<sup>6</sup> showed using high-quality, audited, clinical data, we compared the 30-day outcomes of CA, UA, and EA patients. We have confirmed that CA places the patient at relatively high risk, a finding similar to those reported in both a large-cohort study and in a nationwide study. We also showed that the risk associated with EA is significantly lower than for any of the other choices. It is worth noting that the NCD data in this study were similar to those from the ACS NSQIP<sup>11</sup> and the National (Nationwide) Inpatient Sample. Stratifying management based on the UA/CA status of the patient can improve appendicitis treatment outcomes, although many patients continue to have an equivocal diagnosis, which remains a challenging dilemma.

Alotaibi, AM et al (2022)<sup>7</sup> showed complicated appendicitis correlates with significant morbidity, readmission rate, and 6 times more hospital LOS than simple appendicitis. This review might help in appreciating the burden of complicated appendicitis on hospital length of stay, which needs allocating patients and planning the discharge day for hospitals with limited beds.

Symeonidis, NG et al (2022)<sup>8</sup> showed preoperative hyponatremia is associated with complicated appendicitis. Serum sodium levels, a routine, low-cost laboratory test, could act as an accessory marker aiding surgeons in earlier identification of gangrenous or perforated acute appendicitis.

**DISCUSSION**

Acute appendicitis (AA) is a commonly encountered surgical emergency at all levels of seniority and across different specialties. First described by Fitz in 1886, it is characterized by inflammation of the vermiform appendix. Treves is credited as the first to treat AA in 1902. AA occurs when there is obstruction of the appendiceal orifice (such as lymphoid hyperplasia or fecaliths), resulting in inflammation. This causes progressive distension of the appendix, eventually leading to vascular compromise, allowing the growth of pathogenic microorganisms. Left untreated, this culminates in the perforation of the appendix with a localized abscess or generalized peritonitis.<sup>9,10</sup>

The rate of perforation varies from 16% to 40%, with a higher frequency occurring in younger age groups (40–57%) and in patients older than 50 years (55–70%). Appendiceal perforation is associated with increased morbidity and mortality compared with non-perforating AA. The mortality risk of acute but not gangrenous AA is less than 0.1%, but the risk rises to 0.6% in gangrenous AA. On the other hand, perforated AA carries a higher mortality rate of around 5%. Currently, growing evidence suggests that perforation is not necessarily the inevitable result of appendiceal obstruction, and an increasing amount of evidence now suggests not only that not all patients with AA will progress to perforation, but even that resolution may be a common event.<sup>11</sup> diagnostic algorithm using ultrasound as the primary imaging strategy after history taking, clinical examination, and blood tests. If ultrasound is not diagnostic, we recommend performing a computed tomography (CT) scan or, if available, magnetic resonance imaging (MRI). In pregnant women, MRI should be performed instead of a CT scan. This strategy has shown to reduce the use of a CT scan in up to 50% of cases while achieving a diagnosis in 90% of patients with acute abdominal pain.<sup>12</sup>

Since the first appendectomy was performed by McBurney in 1864, surgical removal of the appendix has been considered the standard of care for acute appendicitis. Initially performed via laparotomy, laparoscopic appendectomy has now become the new standard of care in the Western world. In recent years, increasing evidence has emerged, showing that NOM is a genuine alternative treatment option at least in some clinical scenarios. Although many cornerstones have yet to be defined, appendicitis is more and more becoming a disease with many different facets/aspects that require different therapeutic strategies.<sup>12</sup>



Appendicectomy has been accepted as the gold standard for the management of appendicitis over the years, but there has been an increasing evidence and trend toward the conservative approach to the management of appendicitis with debates on the equivalence of treatment efficacy in both approaches. Coldrey in 1959 was the first to mention the successful treatment of appendicitis using the conservative approach. Since then, various studies which aim to evaluate the effectiveness and safety of nonoperative treatment of appendicitis have been conducted.<sup>13</sup>

## CONCLUSION

Laparoscopic appendicectomy is becoming the gold standard for the treatment of appendicitis. However, the advantages of the innovations in minimally invasive and endoscopic surgery are unlikely to render formal open appendicectomy obsolete. Nonoperative management with antibiotics may suffice in selected cases with uncomplicated appendicitis.

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