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TO CUT OR NOT TO CUT. ANTIBIOTIC USE IN ACUTE APPENDICITIS IN ADULT, PREGNANT AND PEDIATRIC POPULATIONS. REVIEW

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ABSTRACT

Background. Acute appendicitis is one of the most common and routinely performed emergency surgeries in a wide range of populations. Appendectomy is commonly considered as the one and only solution for acute appendicitis
Research objective. This review aims to raise awareness on different approaches to treating acute appendicitis, comparing antibiotics and surgery treatment strategies.
Material and methods. We searched PubMed and ReaserchGate databases, as well as current editions of renowned surgery textbooks for systematic reviews, articles, studies and meta-analyses surrounding the topic of treatment strategies and their complications for acute appendicitis in different populations.
Results. In the adult population a higher success rate for surgical treatment was reported (82,3%) than the antibiotic one (67,2%). Antibiotic use in the pregnant population was associated with a lower rate of preterm deliveries, but an increased rate of infectious complications due to suspected immunological changes during pregnancy. In children, antibiotic treatment was associated with a 90,5% treatment success rate with histopathologically confirmed recurrence rate during the 1 year follow up of 16,1%.
Conclusions. Surgery treatment offers a higher rate of treatment success than antibiotic management and lower recurrence rate. Conservative treatment may be more beneficial than surgery to specific groups of patients under the condition of confirmed uncomplicated appendicitis.

KEYWORDS

Acute Appendicitis, Appendectomy, Pregnancy, Pediatric Population, Adults, Antibiotics

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1. Introduction

Appendicitis is one of the most common causes for urgent medical procedures a surgeon may come across during their practice. In the United States it's responsible for as many as 300 000 hospitalizations annually (Wray CJ, Kao LS, Millas SG, et al, 2013). Given that lifetime incidence of appendicitis is 8,6% in men and 6,7% in women it's crucial to be able to swiftly and correctly diagnose a patient presenting with its symptoms(Addiss et al. 1990). Appendicitis occurs most frequently between the ages of 10 and 19, with lowest incidence in children ≤ 9 years old (Golz et at, 2020, Addis et al. 1990).

The vermiform appendix is a midgut organ located at the base of the cecum. It can be already identified at 8 weeks gestation as a small outpouching of the cecum, which given time elongates and rotates into its fixed position in the right lower quadrant **(**Wray CJ, Kao LS, Millas SG, et al, 2013). The appendix is a true diverticulum of the cecum, considering it being made up of all four layers of the colonic wall (Mulholland MW, Lillemoe KD, Doherty GM, et al. 2005). Appendix also has its own blood supply through the appendiceal artery and its own mesentery called mesoappendix. The base or the orifice of the appendix is fixed to the cecum, but the tip can migrate to nearby regions such as retrocecal, which is the most common one, pelvic and retroperitoneal area. These variations result in different abdominal pain presentations additionally complicating the diagnosis.

The role of the appendix is not yet fully discovered. It is speculated that because of the high density of submucosal lymphoid tissue it plays a role in the immune system. Its build may also suggest that it serves as the reservoir of "good" interstitial bacteria restoring bacterial balance to the intestines after events such as antibiotic treatment (Girard-Madoux et al, 2018). Bacterial flora of the cecum comprises gram-negative bacteria and anaerobes with common isolates such as E. coli, P. aeruginosa, K. pneumoniae and others (Townsend et al, 2022).

Prompt surgery remains the gold standard for treatment of acute appendicitis and is regarded as the least controversial one. Whether or not the patient undergoes the appendectomy, broad-spectrum antibiotics should be administered. The use of appropriate agents that address aforementioned cultures is paramount for fewer surgical site infections and better outcomes. Antibiotic treatment is an indispensable part of the acute appendicitis management whether it be a coverage alongside surgical method or a primary role in non-operative treatment.

The aim of this article is to raise awareness about the methods and procedures of antibiotic treatment in acute appendicitis, and to emphasize the importance of knowledgeable decision making when choosing the appropriate course of action for each patient.

2. Methodology

A literature review was conducted using the following keywords in the PubMed and ResearchGate databases: “acute appendicitis”, “appendicitis”, “antibiotic treatment”, “appendectomy”,”pregnant population”, “adults”, “children” “pediatric population”. Renowned published textbooks of surgery were also considered for this review.

3. Research results

Perioperative antibiotic use

Complicated, perforated appendicitis is associated with a high risk of postoperative infections, particularly intra-abdominal abscess formation (Fraser et al., 2010). These complications in turn are causes for longer hospitalization and higher costs of treatment. Systematic review and analysis of post-operative antibiotic duration in an acute complicated appendicitis conducted by Ramson et al. in 2021 found no clear benefit to prolonged antibiotic treatment in acute appendicitis or either of the aforementioned complications. Furthermore there was no statistically significant difference between short-term (≤5 days) and extended (>5 days) antibiotic duration in prevention of intra-abdominal abscesses. Extended antibiotic treatment was not associated with reduced incidence of surgical site infections (Ramson et al, 2021). Guidelines suggested by the Surgical Infection Society and the Infectious Diseases Society of America recommend limiting the antimicrobial therapy to 4 to 7 days provided that adequate source control has been achieved in cases of intra-abdominal infection (Solomkin et al, 2010). Most studies analysed by Ramson et al. used various regimes of cephalosporins or metronidazole, solely or in combination. Two studies also included penicillins and aminoglycosides.

However in non-complicated appendicitis postoperative antimicrobial treatment was associated with higher rates of C. Difficile infections and urinary tract infections (Coakley et al, 2011)

Adult population

So far many studies have promoted antibiotic treatment omitting surgery for patients with uncomplicated appendicitis suggesting high success rates. Systematic review and meta-analysis by Podda et al. took into account several methods of measuring success. One of those was complication-free treatment including treatment failure. Studies in this group reported significantly higher success rate for surgical treatment (82,3%) than antibiotic one (67,2%). Observation for long term solution was also conducted, at 1-year follow up 93,1% success rate was associated with surgery and 72,6% with antibiotic treatment (Podda et al, 2019).

The overall rate for recurrence of appendicitis was 19,2%. Post intervention complications were also taken into account with antibiotic treatment having significantly lower rate compared to appendectomy (7,1% vs 14,5%). Interestingly, analysis of reported surgical complications in both methods of treatment yielded an essentially equivalent rate of 12,8% in the antibiotic and 13,6% in the surgical group. The overall rate of wound infection, bowel obstruction, incisional hernia and abscess formation were similar between these two groups. Antibiotic treatment was associated with significantly lower costs when compared to surgical approach even after including antibiotic treatment-failure and subsequent surgery (4074$ vs 5117$). There was no statistically significant difference in length of primary hospital stay. However non-randomised controlled trials reported shorter hospital stay of patients treated with antibiotics (Podda et al, 2019). Reported results show advantages of both approaches and are best to be evaluated having a specific patient in mind.

Distinguishing which patient may respond well to antibiotic treatment may be complex. Patients with assumed uncomplicated appendicitis who fulfilled criteria set by Hansson et al, had 89% chance of recovery with antibiotics. The criteria being CRP<60g/L, WBC <12x10^9/L and age <60 years (Hansson et al, 2014). Another study reported higher success rate of non-operative treatment in patients whose symptoms lasted longer than 24 hours prior to admission, explaining that lack of progression to complicated appendicitis in that

period of time is associated with indolent clinical progression. There were other factors that increased the success rate of antibiotic treatment such as Alvarado score <4, lower temperature, imaging-confirmed uncomplicated appendicitis and smaller diameter of the appendix (Loftus et al, 2018). Computed tomography is considered to be an essential part of confirming appendicitis in adults (Kim et al, 2012). CT scans are known for high sensitivity and specificity. Their usage has resulted in reduction of negative appendectomies without increasing the rate of complicated, perforated appendicitis. (Coursey et al, 2010; Raja et al, 2010; Raman et al 2008). Patients that receive CT aided diagnosis gain better medical care by avoiding excess surgeries which leads to more efficient use of hospital resources (Rao et al, 1998).

Pregnant population

One of the most common reasons for surgical emergencies in the pregnant population is acute appendicitis with prevalence ranging from 1 in 700 to 1500 live births (Abasi et al, 2014). Acute appendicitis is associated with preterm labor, placental abruption, fetal loss and maternal death (Candrawinata et al, 2023). When turning to conservative methods of treatment in acute appendicitis it is important to note that the number of antibiotics safe for the fetus is limited. Patients may also prefer delayed appendectomy in the event of recurrent appendicitis to minimize the risks associated with undergoing surgery during a physiologically vulnerable state.

Meta-analysis conducted by Candrawinata et al, reported usage of third-generation cephalosporins as preferred choice of medication. It was found that the group treated with antibiotics had significantly lower risk of preterm delivery at 1,1% vs 1,68%. There was no significant difference in fetal loss between the two groups.Fortunately, no maternal deaths were reported, rendering analysis of this specific risk unfeasible. The risk of complications such as septic shock, sepsis, vein thrombo-embolism in the antibiotic group was statistically significantly higher compared to surgery. (Candrawinata et al, 2023). Appendectomy was associated with lower risk of peritonitis compared to non-operative treatment (Abbasi et al, 2014). Increased risk of infectious complications in the pregnant population is believed to be associated with immunological changes during pregnancy resulting in decreased strength of immunological response to infectious stimuli (Abu-Raya, 2020). Misdiagnosing pregnant patients with acute appendicitis and subsequently proceeding with appendectomy happens more often than in the general population, with negative appendectomy ranging from 25% to 50% vs 15-35 % in the general population (Kave et al, 2019). Radiological imaging such as CT scans, although helpful in confirming the diagnosis before surgery, carry additional risks for the fetus and are often contraindicated during pregnancy. Prompt MRI scans are often unavailable and ultrasonography scans have lower sensitivity. Therefore a non-operative, antibiotic treatment should be tailored to specific patients with dubious symptoms and negative ultrasonography scans. (Candrawinata et al, 2023).

Pediatric population

Cases of acute abdominal pain make up as much as 10% of pediatric visits to healthcare providers (Buel et al, 2024). Due to anatomical differences and different clinical presentation of appendicitis in children, which also depends on the age of a child, difficulties with proper diagnosis and treatment arise (Emil et al, 2003). That being said, the results of meta-analyses and reviews focusing on adult populations are not applicable to pediatric patients.

Huang et al. conducted a meta-analysis centering around the pediatric population. Initial success rate for antibiotic group was 90,5%, histopathologically confirmed recurrence rate during the 1 year follow up was 16,1% (27/168 patients). All patients reported in this study were primarily treated with third-generation cephalosporins, carbapenems, or penicillins. Appendicitis with appendicolith present was associated with higher rate of initial failure and recurrence of the condition (Huang et al, 2017). Appendicolith is found in approximately 10% of patients presenting with acute appendicitis, especially in children and young adults (Teke et al, 2008) Prevalence of complications such as perforation, abscess in the antibiotic group and surgical site infection or ileus in the appendectomy group was considered not significantly different. The analysis reported a significantly longer hospital stay in the antibiotic group with a mean difference of 14.32 hours (Huang et al, 2017).

However the length of disability because of the condition and its treatment was reported to be longer in the appendectomy group (21 days) than in the antibiotic one (Minneci et al, 2016)

Appendectomy remains a treatment of choice in most children diagnosed with early appendicitis (St Peter et al, 2025) especially in younger children, who are often unable to accurately describe and assess their symptoms.

4. Discussion

Antibiotic treatment is to be proceeded with caution, having the best interest of the patient in mind. Antimicrobial use comes with its increasing challenges. Number of infections caused by multidrug-resistant organisms increased in recent years as a result of careless and excessive prescriptions of antibiotics. Administering other broad-spectrum antibiotics to ensure complete coverage of bacteria associated with appendicitis related infections could open up the patients to increasing drug-resistance and difficulties treating other ailments later on. 9,2% of reported patients with intra-abdominal infections, including complicated appendicitis needed their antibiotics changed from primarily used ones that were administered perioperatively due to antibiotic-resistance (Vinodhini et al, 2023).

Individually tailored strategy on par with evidence based studies and treatment innovations will allow clinicians to make well suited decisions. Certain patients are not fit for surgery due to comorbidities as well as other factors. Population preference also comes into play with half of the surveyed participants preferring antibiotic treatment to avoid surgery, even accepting the rate of recurrence as high as 50% (Bom, 2021).

5. Conclusions

Appendectomy is still a preferred option of treatment in acute appendicitis, especially if a complicated course of disease is suspected. That does not exempt clinicians from constantly educating themselves and informing the patients about possible treatment strategies and including their perspective into the treatment plan.

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