Complicated Appendicitis during the COVID-19 Pandemic and Pre-Pandemic

Subjects: Surgery

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The Coronavirus Disease 2019 (COVID-19) pandemic has impacted volume, management strategies and patient outcomes of acute appendicitis. There is a significantly higher incidence of complicated appendicitis in children during the COVID-19 pandemic than in the pre-COVID-19 period. Additionally, a significantly higher proportion of children was managed via the NOM during the pandemic in comparison to the pre-pandemic period.

Keywords: acute appendicitis ; appendectomy ; Coronavirus Disease 2019 ; COVID-19 ; non-operative management

1. Introduction

Acute appendicitis is the most common condition in the pediatric population that leads to emergency abdominal surgery [1][2]. Although advanced diagnostic imaging is widely available, the initial diagnosis of appendicitis in children can be challenging, with rates of misdiagnosis reaching 100% in children aged two years or younger [3][4][5][6]. This has been attributed to nonspecific presentation and overlap of symptoms with other common childhood conditions such as mesenteric lymphadenitis, gastroenteritis, or Meckel's diverticulitis. Clinical scores, such as Alvarado, appendicitis inflammatory response score, and pediatric appendicitis score have been developed to aid the diagnosis of acute appendicitis in children [3][4]. The diagnostic delay often leads to a higher incidence of complications, such as perforation. Perforation rates show an inverse relation to age, ranging from 47.3% in children five years of age, to 100% in children under two years of age [5][6]. Elevated inflammatory markers from blood or even hyponatremia and hyperbilirubinemia have been shown to assist in distinguishing between simple and perforated appendicitis [7][8][9]. Despite advances in medicine, especially in imaging diagnostics, acute appendicitis still in a certain percentage of patients remains unrecognized and mistreated in the initial stage of the disease [1][8][9].

In addition to all diagnostic challenges, the Coronavirus Disease 2019 (COVID-19) pandemic has become a new obstacle to overcome. The pandemic has disrupted the normal practice of economy, governance, and scientific and medical expertise [10]. Confinement measures, introduced in order to minimize the number of infected people, have had an impact on patients, medical procedures, and healthcare workers [11]. Many governing bodies have recommended the cancellation of elective surgical procedures during the pandemic, resulting in a major burden on healthcare systems [12]. A decline in admission rates for numerous medical and surgical conditions has been observed, possibly due to a generalized public fear of presenting to a hospital during the pandemic [13][14][15][16][17]. Despite the confinement measures, acute appendicitis does not quarantine [18]. The pandemic has impacted volume, diagnostic and management strategies, and patient outcomes of acute appendicitis [19][20]. A nationwide study in the United States found a significant decrease in acute appendicitis presentation, while two studies from Germany observed a decrease in the number of appendectomies during the lockdown [19][21][22]. Additionally, it was suggested that non-operative management (NOM) could be a safe alternative to surgery during the pandemic [23][24][25]. A study from Budapest suggests that a higher number of perforated appendices is in line with international trends, and shares no correlation with the COVID-19 pandemic [24]. In contrast, various studies have also demonstrated no significant differences in the rates of complicated appendicitis among children presenting during the pandemic versus the pre-pandemic period [19][20]. Due to these conflicting findings, there is no consensus statement regarding the incidence of complicated appendicitis among the children presenting during the pandemic.

2. Complicated Appendicitis during the COVID-19 Pandemic and Pre-Pandemic

A classification of complicated appendicitis is given when there is evidence of a perforated or gangrenous appendix, an intra-abdominal abscess, or fecal peritonitis, which often results in a longer length of stay and greater rates of morbidity and mortality. Overall, complicated appendicitis is more common in children, with rates as high as 30% [6][26]. One of the

reasons for the higher incidence of complicated appendicitis in young patients is diagnostic delay. The diagnostic delay is partly due to unclear anamnesis and atypical clinical presentations found in young patients. Studies showed that appendicitis is a diagnostic challenge with 7–15% of cases presenting twice to the emergency department before diagnosis, resulting in an increase in the rate of complications [27][28][29]. The risk of perforation within 24 h of the onset of symptoms is substantial (7.7%), and it increases in a linear fashion with duration, especially with prehospital delay, moreso than with admitted children [30]. Socioeconomic factors, which are globally worsened by ongoing COVID-19 pandemic, are also important factor in delayed presentation of pediatric patients as seeking medical care is dependent upon parents' knowledge of illness, transportation options, insurance status, and financial wellbeing [31][32]. Another reason for higher incidence of complicated appendicitis in young patients is misdiagnosis. Misdiagnosis is due to the fact that the classical clinical symptoms and laboratory findings that are common in older pediatric population are missing in the younger [4]. Patient age is tied closely to the stage of acute appendicitis, so the youngest patients present with more advanced stages of disease and are at greater risk of perforation, with recent study showing a significant increase of perforation in relation with age as follows: 100% < 1 year; 100% 1–2 years; 83.3% 2–3 years; 71.4% 3–4 years; 78.6% 4–5 years and 47.3% of 5 years [6]. Studies also demonstrate that using various clinical methods (clinical exam, laboratory tests, imaging and clinical scores), the availability of which can be reduced during COVID-19 pandemic, is associated with a reduction in the negative appendectomy rate from 14% to 4%, with a slight reduction in the rate of perforated appendicitis [33].

The most accepted mode of treatment of acute appendicitis is appendectomy following fluid resuscitation, analgesia, and intravenous antibiotics. Laparoscopic appendectomy is the most common surgical option with known benefits of lesser incidence of postoperative ileus, a shorter hospital stays, reduced analgesic requirements, a reduced incidence of wound infection and less risk of subsequent adhesive bowel obstruction [1][34][35][36][37]. Intra-abdominal abscess rates are similar after laparoscopic and open appendectomy and are largely determined by whether the appendix is perforated or not [1][34][35][36][37]. Another option for treatment is NOM (conservative therapy) which can represent a feasible option for acute appendicitis, although complication-free treatment success rates are higher with surgical treatment [1]. NOM with antibiotics may fail during the primary hospitalization in about 8% of cases, and an additional 20% of patients might need a second hospitalization for recurrent appendicitis [38].

All of the aforementioned factors in diagnosis and treatment of pediatric appendicitis are being affected by the ongoing COVID-19 pandemic. Since it started in March of 2020, the COVID-19 pandemic represents significant global health threat, a political challenge and has severely affected human life and welfare [11][39]. Extensive measures, most significant being lockdowns, have been implemented to lower person-to-person transmission and to stop distribution of virus. In the beginning of the pandemic, lockdowns and "Staying home" were most common means to prevent transmission of the virus. During the COVID-19 pandemic elective surgical procedures were canceled in most centers. Surgical procedures were limited only for the care of urgent surgical patients [12][13][14][15][16][17][40][41]. These efforts to minimize unnecessary traffic through the healthcare facility resulted in a significant reduction in emergency department patient encounters [39][41].

There is a significantly higher incidence of complicated appendicitis among the children in pandemic group versus non-pandemic group. There is a significantly higher proportion of children managed via the NOM during the pandemic versus pre-pandemic period [42][43][44][45][46][47].

Significantly higher complicated appendicitis rates during the pandemic can be explained by multiple factors. Delayed presentation of pediatric patients, in general, and higher incidence of NOM during pandemic, are the most important ones. Socioeconomics and delay in time from admission to surgery because of pandemic protocols could be speculated as minor factors [48]. The risk of perforation and other complications increases in a linear fashion with duration of disease, especially with pre-hospital delay more than with admitted children. Several studies recorded longer prehospital delay in admission of acute appendicitis during the pandemic [9][42][49][44][50][46], while other studies showed no significant difference between pandemic and pre-pandemic delay of presentation [42][51][52][50][53][47]. Significant increases in delayed care for different medical emergencies, including pediatric surgical emergencies, during the COVID-19 pandemic period have been noted by the medical community and published in several reports [54]. The effects of the COVID-19 pandemic are recorded in other urgent pediatric surgery conditions such as testicular torsion, in which latest studies show significantly longer time from testicular torsion symptom onset to presentation during the pandemic and a significantly higher proportion of patients reported delaying care [17][55]. Recent studies show that the outbreak of the COVID-19 pandemic is associated with a delay in presentation of patients with most common medical emergencies such as acute ischemic stroke and delay of diagnosis of colorectal carcinomas, which will lead to a massive downstream impact on healthcare [56][57]. Delayed presentation can be explained by avoidance of unnecessary hospital visits in the absence of severe symptoms and reduced or delayed access to medical care due to parental fear of children's exposure to COVID-19.

As per the findings from recent adult/pediatric studies, the patients developing appendicitis during the pandemic reach healthcare facilities on time (similar to the pre-pandemic period). Although an identical management algorithm of acute appendicitis was followed during the two time periods, more reliance on non-operative management was observed among the surgeons during the COVID-19 pandemic [58][59]. The main reasons for NOM were the risk of false negative testing and prevention of viral transmission to healthcare workers in the operating room as well as to minimize hospital resource utilization. Additionally, it could be speculated that more patients asked for non-surgical treatment strategies during the pandemic as compared with the cases before the outbreak, with the fear of hospital admission and acquiring the COVID-19 infection from the hospital.

Open surgery is suggested as a possible approach because of the shorter operation time and lower risk of COVID-19 transmission [60][61]. Widespread use of laparoscopic approach and surgeons not being familiar with open surgery could be a reason for higher incidence and more reliance on NOM during pandemic.

Fonseca et al. reported a 56% reduction in the number of appendectomies performed in pandemic group in comparison with pre-pandemic, and Percul et al. reported a reduction of 25% in total number of acute appendicitis cases [42][53]. It could be speculated that during COVID-19 pandemic, patients with mild or non-specific symptoms were not seeking medical care because of the concern about acquiring COVID-19 infection. The number of cases that resolved on their own or are treated with antibiotics prescribed by gatekeepers should also be considered. Confounding variables such as movement restrictions, difference between mild and strict lockdown restrictions, travel restrictions, limited resources, studies being researched mainly in tertiary centers, and other pandemic-induced changes should also be acknowledged [52]. Here additional research is needed and data from outpatient medical care needs to be researched.

There is a significantly higher number of complicated appendicitis during the COVID-19 pandemic compared with pre-COVID-19 period. Additionally, the study demonstrates an increase in NOM of appendicitis during the pandemic. Both outcomes are direct effect of the COVID-19 pandemic. Management of pediatric appendicitis during this pandemic must be evaluated individually for every hospital and its capacity for SARS-CoV-2 testing, laboratory tests, imaging options, bed, staff, emergency ward capacity and personal protective equipment capacity. Although appendectomy should not be impacted by restrictions on elective procedures several institutions, countries and professional associations recommend performing NOM for appendicitis during pandemic [62].

COVID-19 fundamentally changes the way emergency wards and hospitals function and deliver patient care. The overflow of COVID-19 patients and the effects of the pandemic on health systems, in general, influenced emergency and pediatric specialties wards, which condensed as both elective and emergency care across pediatric specialties decreased and many of these wards were converted to adult wards to accommodate the overflow of adult COVID-19 patients. There were numerous considerations and limitations to consider while delivering patient care, attempting to limit hospital stays while also limiting the number of operations. In conclusion, COVID-19 is a global pandemic, challenging healthcare systems worldwide. During these challenging times, we address the importance of a comprehensive evaluation, physical examination, appropriate and effective treatment in children suspected of having any surgical condition. Balance should be achieved between measures designed to end the pandemic and the appropriate care of pediatric population requiring surgical care.

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