Positive and Negative Rates in Children with Acute Appendicitis

Hind Zaidan, MBBS* Fahad Khalfan, MBBCh BAO** Hussein Ahmed, MBBCh, MRCSEd, EBPS***
Martin T. Corbally, MBBCh FRCSI, FRCSEd, FRCS (Ped Surg)****

Background: Acute appendicitis remains the most misdiagnosed condition worldwide. Children tend to present with a variety of clinical symptoms, may have difficult communication and could be difficult to examine.

Design: A Retrospective Study.

Setting: King Hamad University Hospital, Bahrain.

Method: One hundred thirty-six patients who had appendectomy were reviewed between 1 May 2012 and 31 March 2016. The final diagnosis of acute appendicitis was the histological analysis of the excised specimen.

Result: One hundred thirty-six underwent appendectomy and were included in this study between 1 May 2012 and 31 March 2016. One hundred sixteen (85%) patients had uncomplicated appendicitis and 16 (12%) patients had complicated appendicitis. Four patients were histologically negative; Negative Appendectomy Rate (NAR) was 2.9%. Twelve patients had perforation; therefore, the Perforation Rate (PR) was 8.8%. Sixty-six (49%) laparoscopic appendectomies and 70 (51%) open appendectomies were performed. There was no significant difference between hospital stay and surgical technique; the average stay was 4.3 days.

Conclusion: Our study has demonstrated NAR of 2.9% for a histologically normal appendix; a perforation rate of 8.8%. This study revealed the need for a prospective study for the pediatric acute abdomen and a dedicated radiological resource focused on pediatric radiology. The diagnosis of appendicitis in children remains largely clinical with appropriate use of US.

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Uncomplicated acute appendicitis was defined as an inflammation of the mucosal lining and the wall of the vermiform appendix, while, complicated appendicitis was defined as an appendicular mass, with or without pus, macro perforation (clinically visible), or peritonitis (pus or fecal). Lymphoid hyperplasia with associated peritoneal signs was included in this diagnosis.

Abdominal pain in children is different from abdominal pain in adults; they lack defined symptoms, signs, and pathophysiology and require a very different clinical skill set[1]. Classical adult presentations may be absent or disguised in children, especially in the very young, who often present with more advanced appendicitis making the diagnosis and management more challenging[2-4]. Despite these issues, the Negative Appendectomy Rate (NAR) in children has remained significantly lower compared to adults, and pediatric surgeons rarely use any imaging other than US. However, US has limitations in certain body types and is user variable. CT has a significant risk of accumulated radiation exposure. MRI is not widely available nor accessible on a 24-hour basis; in addition, MRI is expensive[5,6].

The widespread use of diagnostic aids such as US and CT has influenced the accuracy of diagnosis; appendicitis still remains to be the most misdiagnosed condition worldwide[7].

The antibiotic administration was guided by the antibiotic guidelines in the management of acute appendicitis in children, Seattle Children's Hospital 2014 and King Hamad University Hospital antibiotic policy[8].

This study aims to evaluate the NAR and compare clinical preoperative diagnosis with operative findings.

* Registrar
Department of Pediatric Surgery
** Intern
Department of Internal Medicine
*** Senior Registrar
**** Consultant and Chief of Medical Staff
Department of Pediatric Surgery
King Hamad University Hospital
Kingdom of Bahrain
E-mail: hind.zaidan@khuh.org.bh

METHOD

All children admitted with abdominal pain (a total of 434) were reviewed. One hundred thirty-six patients who underwent appendectomy between 1 May 2012 and 31 March 2016 were included in this study. Patients who left against medical advice or have missing data were excluded.

The decision to operate on patients diagnosed with an acute abdomen was made on clinical grounds and after serial examination. Both laparoscopic and open surgical techniques were employed in the management of these patients. Personal characteristics, clinical, laboratory and radiological findings were reviewed using standard proforma. Simple descriptive statistics were used throughout this study.

RESULT

One hundred forty-one patients underwent surgery. Five patients were excluded because they operated upon for reasons other than acute appendicitis (acute cholecystitis, bowel obstruction, ovarian torsion, small bowel duplication cyst and intussusception). Therefore, 136 patients were operated on with the clinical diagnosis of acute appendicitis and were included in this study, 46 (34%) were females and 90 (66%) were males.

Sixteen (11.8%) patients had complicated appendicitis, 116 (85.3%) patients were uncomplicated, 1 patient had a micro-perforation which was included in the uncomplicated group and 4 (2.9%) patients had normal histology. The complicated appendicitis were 16 cases, 4 (2.9%) appendicular masses, 12 (8.8%) with macro-perforation. Macro-perforation was evident intra-operatively with findings of purulent peritonitis, fecal contamination, or a visible breach in the appendicular wall. Micro-perforation, as defined and reported histologically, was not considered a complicated appendicitis in the absence of gross macro-perforation; it was noted in 1 (0.7%) patient only. The perforations were found in 12 (8.8%) patients.

Ninety (66%) patients had definite acute inflammation on histological examination. Twenty-four (17%) patients were found to have lymphoid hyperplasia; two had a fecalith and two had helminthic infestation. Micro-perforation of the appendiceal wall was found in one (0.7%) of 13 perforations, the remaining 12 (8.8%) were diagnosed macroscopically (pus in the peritoneal cavity, or peritonitis). A histologically normal appendix was found in four (2.9%) patients, negative appendectomy rate (NAR) of 2.9%. An isolated fecalith was found in one (0.7%) patient. An appendicular mass was noted in four (2.9%) patients, and two (1.5%) subsequently formed an abscess requiring drainage.

Admission to operating room's time was 10.9 (range 1 to 80) hours for uncomplicated appendectomy and 6.2 (range 3 to 28) hours for complicated appendectomy. This group excludes patients operated for other causes and patients with more complex appendicitis including appendicular mass and/or abscess, where they are operated on at 6-8 weeks. Two (1.5%) patients were readmitted prior to the elective date for worsening symptoms and had an interval appendectomy at an earlier date.

Laparoscopic appendectomy was performed on 66 (48.5%) while open appendectomy was performed on 70 (51.5%). Open appendectomy was generally performed in non-obese patients through a 2-3 cm Lanz incision and did not result in significant delay in discharge from hospital. Patients treated via a laparoscopic approach stayed an average of 4.4 days and open approach, 4.6 days.

All patients were treated with second-generation Cephalosporin and Metronidazole. In complicated appendicitis, Gentamycin was added, and Cephalosporin was occasionally changed to Co-amoxiclav. Patients with inflamed appendicitis received three doses (or 24 hours) of Cefuroxime and Metronidazole postoperatively. Those with suppurative appendicitis received a postoperative course of antibiotics for 48-72 hours. The group of perforated appendicitis (macro-perforation) completed a 5-day course of Co-amoxiclav or Cefuroxime plus Gentamycin and Metronidazole. Patients who had complicated appendicitis were treated with delayed appendectomy and completed 5-7 days of IV antibiotics (triple therapy) and discharged on one more week of Metronidazole and Co-amoxiclav.

Complications were divided into minor and major which accounted for 17 patients (12.5%) and 2 patients (1.5%), respectively. Seven (5%) minor complications included wound infections and 10 (7%) mild postoperative fluid collections, which were managed conservatively. Two patients (1.5%) had inraperitoneal collection and one (0.7%) had a wound infection and intraperitoneal collection. Both patients required drainage.

Nine (6.6%) patients were readmitted, 2 (1.5%) with complicated appendicitis, 1 (0.7%) patient with an intra-abdominal collection and 6 (4.4%) patients for additional pain relief.

Ultrasound and CT were used to investigate acute appendicitis. The presence of one of the following parameters supported a radiological (US) diagnosis of acute appendicitis: dilated appendix, fecalith, appendicular mass, signs of perforation such as a breech in the appendicular wall with significant fat stranding or free fluid surrounding the appendix, see figures 1 and 2. Non-specific US findings included mild free fluid in the pelvis, prominent mesenteric lymph nodes, ovarian follicle or a non-visualized appendix.
Ninety-seven (71%) patients had ultrasound; 55 (40%) were

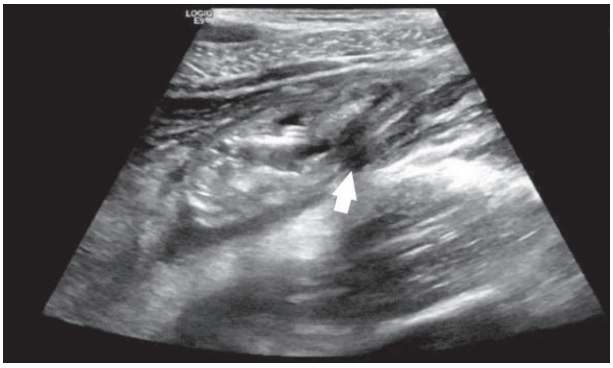

Figure 1: Appendicular Mass and Inflamed Omentum

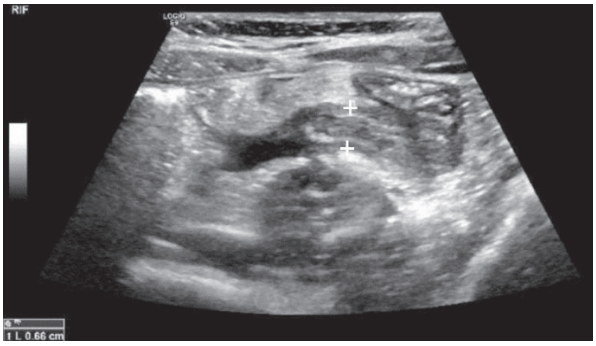

Figure 2: Ultrasound Showing a Blind Ending Tubular Appendix with Wall to Wall Thickness of 66 mm with Surrounding Inflammation

suggestive of appendicitis, 42 (30.9%) patients revealed soft findings and were not regarded as diagnostic of appendicitis. However, 39 (28.7%) of these were subsequently shown to be histologically abnormal by our standard definition. CT was used in 7 (5%) patients when the diagnosis of acute appendicitis was clinically equivocal. Our clinical approach is summarized in figure 3.

DISCUSSION

The diagnosis of acute appendicitis has changed significantly, but it remains the most misdiagnosed condition worldwide. NAR of 15% to 25% has been an acceptable figure for adults[9]. Recently, our hospital has reported 10% NAR and 10% perforation rate in adults[10]. That may be due to the increased use of radiology services[11,12]. The combined use of CT and US resulted in significant reduction in NAR to as low as 7%[13]. However, CT has limited utility in children because of the radiation dose. The average reported negative rates in pediatrics is approximately 6% to 7%[14]. In this study, NAR was 2.9%, only four patients had normal histology, which is less than Pediatric NAR range of 3.6% to 12%[14-17].

This study revealed a perforation rate of 8.8%, which is well below the international rates of 18% to 52%. Perforation most commonly occurs in children under the age of 5 years and is as high as 50% in some studies[16,17]. Our perforation rate in this age group was 1.4%. This figure is too small to allow an accurate comparison. The reported NAR for patients less than five years of age is 7% to 10% and for perforation is 30% to 53%[16,17].

Patients with lymphoid hyperplasia on histology were included in the acute appendicitis group as they had signs of appendicitis. It is believed that luminal obstruction occurs because of hyperplasia causing lymphatic and venous congestion and appendicitis[18]. Acute appendicitis coincides with the age of lymphoid development peaking between 10-30 years of age with a higher incidence in the first two decades of life[19].

CT scans may confirm a suspected appendicitis, but there are concerns over radiation exposure in children[21]. Seventy-one percent of the patients had US, and 39% was suggestive of appendicitis (dilated appendix, significant amount of free fluid, thickened appendiceal wall, appendicular mass signs of perforation and presence of a fecolith); 30% patients revealed minimal free fluid, prominent mesenteric lymph nodes, which

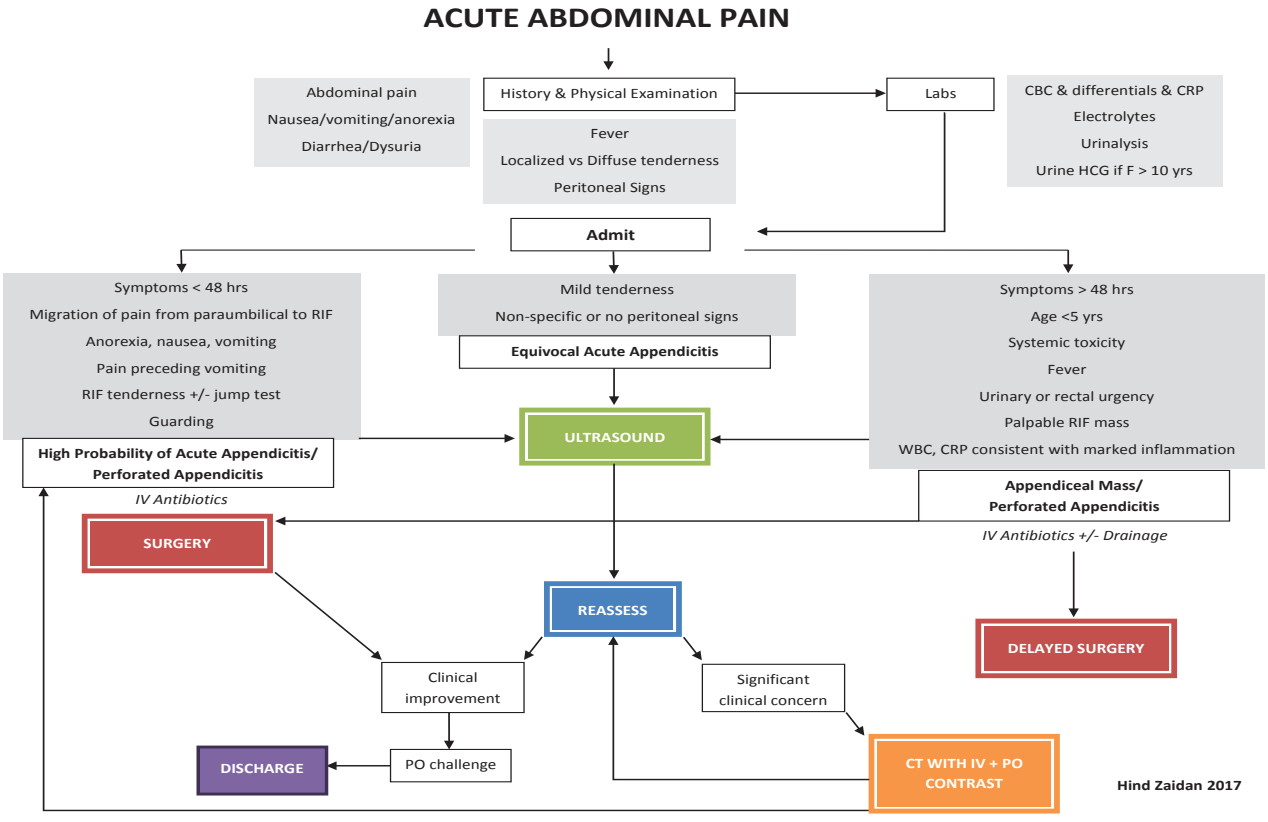

Figure 3: Algorithm Acute Appendicitis

were not regarded as diagnostic of appendicitis. However, 28% revealed abnormal histology. CT was used in 5% patients when the diagnosis of acute appendicitis was clinically equivocal[22].

Forty-seven percent of our patients underwent laparoscopic approach, and 50% were open. In thin patients, we performed an open procedure.

CONCLUSION

Our study has demonstrated a negative appendectomy rate of 2.9% for a histologically normal appendix. The overall perforation rate in this study was 8.8%. The accuracy of diagnosis in the acute pediatric abdomen continues to improve. Reliance on ultrasound as a non-interventional and available diagnostic tool has increased clinicians and societal expectations. Despite ultrasound findings, diagnosis of acute appendicitis in children remains largely clinical.

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