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Management and Outcome of Acute Appendicitis in Pediatrics; Our Experience at Queen Rania Al Abdullah Hospital for Children

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Abstract **Original Research Article**

Objectives: the purpose of our study was to report our experience at Queen Rania Al Abdullah Hospital for Children (QRHC) in the diagnosis and management of acute appendicitis regarding the outcome, complications and hospital stay. ***Method:*** A retrospective study was carried out at QRHC by reviewing the medical records of patients who were younger than 14 years that admitted to pediatric surgical ward in the period from Jan 2019 to Jan 2020 with a diagnosis of acute appendicitis. The study included 196 patients, 116 were males and 80 were females with a male to female ratio of 1.45:1. The ages of the patients ranged from 3 years to 14 years with the highest incidence between 10 -13 years. The duration of symptoms ranged from 8 hours to 1 week. The period of hospital stay ranged from 1 to 8 days with a median stay of 2 days. ***Results:*** all patients underwent appendectomy, 120 via open approach and 76 by laparoscopy with only 1.53% conversion rate to open (3 cases). 110 cases (56.1%) were non complicated appendicitis while the remaining 86 cases (43.9%) were complicated (perforated appendix), of those 20 cases were less than 5 years old. The rate of negative appendectomy (histopathological normal appendix) was 11.2% (22 cases). Fever was presented in 60 cases (30.6%) and leukocytosis was presented in 130 cases (66.3%).U/S was suggestive of acute appendicitis in 108 patients (55.1%) while the appendix was not visualized in the remaining 88 patients. CT scan was required in 40 patients (20.4%). The overall postoperative complications was 10.7% which occurred in 21 patients, 8 patients (4.1%) developed post-operative ileus , 6 patients (3.1%) complicated with wound infection, 4 cases (2%) developed intra-abdominal abscess and 3 patients (1.5%) had intestinal obstruction. ***Conclusion:*** Acute appendicitis is the commonest cause of abdominal surgical emergency in pediatrics and a common cause of misdiagnosed surgical emergency in children. Delayed diagnosis can result in serious complications as perforation, peritonitis, septicemia, intra-abdominal abscess and intestinal obstruction therefore accurate diagnosis and prompt treatment are mandatory to avoid these morbidities.

Key words: acute appendicitis, appendectomy, complications, perforated appendix.

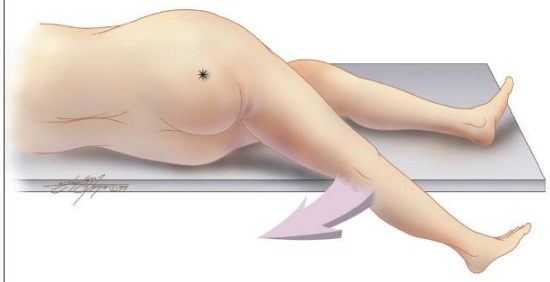
INTRODUCTION

Acute Appendicitis (AA) is an acute inflammation of the appendix that results in serious complications if not promptly and accurately diagnosed and treated [1]. AA is the most common cause of acute surgical abdomen in pediatrics [2, 3, 4, 5] with 25% of all appendectomies is carried out in children [6]. 1-5% of children with abdominal pain are diagnosed to have AA [7] and the life time risk to develop AA is 7-8% with a peak incidence that occurs between 11-12 years [5, 6, 7, 8].

The etiology of AA in most of the cases is appendicular luminal obstruction due to various causes that results in mucus accumulation, bacterial stasis and overgrowth, increased intraluminal pressure, distention and increased wall tension, impairment of venous and lymphatic drainage that results in wall edema followed by arterial compromise and bowel wall ischemia, necrosis and eventually perforation [5, 8, 9].

The diagnosis of AA is made by history, physical examination and supported by radiological imaging [9, 10] while it is confirmed only by surgery and histological examination [7]. The clinical presentation is variable including abdominal pain, vomiting, anorexia and fever [3, 9] while the most reliable signs are right iliac fossa tenderness, positive psoas sign, obturator sign and rovsing sign [8]. See figure 1 and 2.

FIGURE 1



The psoas sign. Pain on passive extension of the right thigh. Patient lies on left side. Examiner extends patient's right thigh while applying counter resistance to the right hip *(asterisk).*

Illustration by Floyd E. Hosmer

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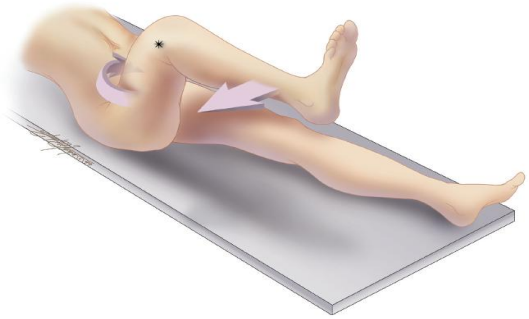
FIGURE 2



The obturator sign. Pain on passive internal rotation of the flexed thigh. Examiner moves lower leg laterally while applying resistance to the lateral side of the knee *(asterisk),* resulting in internal rotation of the femur.

Illustration by Floyd E. Hosmer

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There are no specific lab markers that can definitely confirm the diagnosis of AA despite the elevation of WBC and CRP, because even with normal level of WBC (less than 10,000/Ml) one fifth of patients may have acute appendicitis [9].

Radiological imaging as U/S and CT scan are used to decrease the rate of appendicular perforation, increase diagnostic accuracy and decrease negative appendectomy [6, 7, 9].

U/S is the 1st line imaging of choice in the evaluation of abdominal pain [1, 8, 11], it is safe, available, noninvasive, easy to apply, cheap, and not associated with ionizing radiation nor contrast dye exposure, on the other hand its limitations are being operator dependent that depends on technical skills of the radiologist and its affected by body habitus (more difficult in obese and gaseous abdomen) [12]. The U/S findings of acute appendicitis are dilated appendix more than 6 mm diameter, non-compressible and blind ended tubular structure [1].

CT scan has a higher sensitivity and specificity than U/S in the diagnosis of AA but because of the hazards of ionizing radiation and contrast dye reactions, also the need for general anesthesia for younger patients, add to this that CT scan not always available, costly and takes a longer time, therefore CT scan is not routinely requested rather it is used in questionable cases when U/S is inconclusive or appendix cannot be visualized [6, 12]. Because diagnosis of AA is challenging, researchers and surgeons developed several pediatric scoring systems that used common clinical and laboratory findings as predictors to classify patients into mild, moderate and high risk for acute appendicitis as the Alvarado score (which is the most popular), pediatric appendicitis score and appendicitis inflammatory response score [7, 8].

Alvarado Score In Acute Appendicitis

CATEGORY	EXPLANATION	SCORE
Symptoms	Migration	1
	Anorexia or acetone (in the urine)	1
	Nausea or vomiting	1
Signs	Tenderness in right lower quadrant	2
	Rebound pain	1
	Elevation of temperature (>37.3°C measured orally)	1
Laboratory	Leukocytosis (>10,000/mm3)	2
	Shift to the left (>75% neutrophils)	1
Total Score		10

Score
1-4 Appendicitis unlikely
5-6 Appendicitis possible
7-8 Appendicitis probable
9-10 Appendicitis very probable
Adopted from Alvarado A. A practical score for the early diagnosis of acute

Delayed and missed diagnosis of AA is common because of the similarity of signs and symptoms with other diseases as intussusception, gastroenteritis, mesenteric lymphadenitis and pneumonia, also one third of children have atypical presentation, and the difficulty in obtaining a clear history from pediatrics because the child (especially younger than 5 years) cannot express or communicate well and not cooperative during physical examination resulting in a challenging diagnosis [8, 9, 10, 11, 12].

Delayed diagnosis of AA results in many complications as appendicular perforation, phlegmon, peritonitis, intra-abdominal abscess, intestinal obstruction and septicemia. Therefore accurate diagnosis and early appendectomy is important to avoid these complications [8, 9, 10, 12].

Relieve of abdominal pain due to AA by NSAIDS or opioids is not contraindicated because it doesn't mask or delay the diagnosis, doesn't alter inflammatory process nor change the pediatric scores [8].

METHOD

A retrospective study was conducted at QRHC by searching the medical records of patients who were younger than 14 years that admitted to pediatric surgical ward in the period from Jan 2019 to Jan 2020 with a diagnosis of acute appendicitis.

Data collected was including age at presentation, sex, signs and symptoms, duration of symptoms, U/S findings, WBC level, histopathological result, hospital stay and post operative complications.

The study included 196 patients, 116 were males and 80 were females with a male to female ratio of 1.45:1. The ages of the patients ranged from 3 years to 14 years with the highest incidence between 10 -13 years, the median age were 9 years. The duration of symptoms ranged from 8 hours to 1 week. The period of hospital stay ranged from 1 to 8 days with a median stay of 2 days.

Management protocol

Patients who presented to emergency department with a clinical picture suggestive of AA are admitted to pediatric surgical ward and prepared for appendectomy.

Preparation is done by taking detailed history, performing physical examination, requesting laboratory tests(CBC and urine analysis), performing U/S for patients, keeping patient NPO on intravenous fluids, administration of analgesia for pain control and obtaining a signed informed consent from the parents after explaining for them the whole procedure and its possible complications.

Appendectomy is performed within few hours after admission except for patients who presented after midnight where their procedure is postponed till morning unless patient is septic and can't tolerate any delay.

Non surgical approach is used for patients who have appendicular abscess by giving them IV antibiotics with percutaneous drainage followed by interval appendectomy for patients who developed recurrent appendicitis.

Technique: Appendectomy is performed under general anesthesia via open or laparoscopic approach according to the preference of the surgeon, the patient is laid supine and prophylactic antibiotic is administered at induction.

Open appendectomy:

Lanz incision is performed at the right iliac fossa, abdominal wall is opened in layers till reaching peritoneal cavity, identification of appendix, ligation of mesoappendix with absorbable sutures then appendix is secured at the base and excised followed by cauterization of appendicular stump and closure .

Laparoscopic appendectomy:

Supraumbilical incision is performed, veress needle is introduced and CO2 insufflated with a pressure of 8-12 mmHg to create pneumoperitoneum, another two incisions in right upper quadrant and left iliac fossa for working trocars are performed, identification and dissection of mesoappendix using ligasure, base of appendix is secured using either endoloop or endoclipper and finally appendix is removed through trocar or via retrieval bag. Intravenous antibiotics are continued for 1-2 days for patients with suppurative or gangrenous appendix and for 3 -5 days for those with perforated appendix using double therapy (metronidazole and 3rd generation cephalosporin) or triple therapy. Post-operative Pain control is achieved with analgesics; patient is kept NPO for few hours then allowed to start clear fluids then regular diet as tolerated. Once patient can tolerate feeding, fever subsided, WBC and physical examination are normalized then patient can be discharged safely.

RESULTS

The commonest symptom and sign were abdominal pain and right iliac fossa localized tenderness respectively. Fever was presented in 60 cases (30.6%) and leukocytosis was presented in 130 cases (66.3%) with the highest incidence in complicated appendicitis where 76 cases (88.4%) of the 86 patients with perforated appendix had leukocytosis.

U/S was suggestive of acute appendicitis in 108 patients (55.1%) while the appendix was not visualized in the remaining 88 patients. CT scan was

required in 40 patients (20.4%) where U/S was inconclusive and associated with atypical clinical presentation.

All patients underwent appendectomy including 2 cases that were performed as interval appendectomy, 120 cases via open approach and 76 by laparoscopy with only 1.53% conversion rate to open (3 cases).

110 cases (56.1%) were non complicated appendicitis while the remaining 86 cases (43.9%) were complicated (perforated appendix), of those 20 cases were less than 5 years old, 12 cases had diarrhea and were misdiagnosed as gastroenteritis and 8 cases had pharyngitis and were misdiagnosed as mesenteric lymphadenitis. Two Patients had appendicular abscess that were treated with IV antibiotics and percutaneous drainage followed by interval appendectomy after 3 months due to recurrent appendicitis.The rate of negative appendectomy (histopathological normal appendix) was 11.2% (22 cases).

The overall postoperative complications was 10.7% which occurred in 21 patients, 8 patients (4.1%) developed post-operative ileus ,6 patients (3.1%) complicated with wound infection, 4 cases (2%) developed intra-abdominal abscess , two of them were small abscesses that treated by intravenous antibiotics while the other two cases required percutaneous drainage with intravenous antibiotics, also 3 patients (1.5%) had intestinal obstruction, two of them treated conservatively with NPO,IVF, IV antibiotics and NGT while the last case required laparotomy and release of adhesive bands.

DISCUSSION

Acute appendicitis is the commonest cause of acute abdomen that needs abdominal surgical intervention [7, 9].

The most important complication of AA is appendicular perforation which results in pelvic abscess, peritonitis, sepsis, intestinal obstruction and infertility issues add to this an increase in hospital stay, IV antibiotics requirements and post-operative complications [8]. The risk factors that increase the incidence of perforation are longer duration of symptoms, delayed or missed diagnosis, male sex, U/S findings of free fluid or appendicular diameter 11 mm or more, and younger age group [8, 10] where the incidence of perforation is more than 50% in preschool children and up to 100% in infants [10].

Appendectomy via open or laparoscopic approach is the standard treatment of choice for AA [2, 6, 8]. Conservative treatment with intravenous antibiotics in selected cases of uncomplicated AA may be considered, it has a high resolution rate (70%), it lowers the complication rate and pain control requirements, however 40% will need appendectomy in one year [8].

The most common post appendectomy complications are ileus, wound infection, intra-abdominal abscess and intestinal obstruction [6].

The incidence of negative appendectomy (histopathological normal appendix) in our study was 11.2% and in Ahmet S. Yazar's [11] study it was 15% which were comparable to the literature (10-40%) [7,11].

M.D. Bolmers [6] reported that the overall post appendectomy complication rate was 11.9%, including post operative ileus 2.5%, abdominal abscess 5.9% and wound infection 1.7% which is comparable to our study where the complication rate was 10.7% including post operative ileus 4.1%, abdominal abscess 2% and wound infection

Gabriela L. Jaimez [13] suggested that post operative chewing gum is tolerated, acceptable and safe in children and can promote GIT function (decrease time to tolerate oral feeding and to pass motion or flatus) without complications.

Perforated appendicitis is more common in younger age group because of the challenging diagnosis; the incidence of perforated appendicitis in children younger than 6 years old was 46% in Chih C. Luo's [10] study and 67.9% in M.D.Bolmers's [6] study while it was 32.6% in our study.

Laparoscopic appendectomy is becoming the standard treatment for AA [2,8,14] because it is safe, associated with shorter hospital stay, lower post op pain and analgesic requirements, rapid recovery, lower post op complications (wound infection, abscess), lower rate of negative appendectomy and diagnosis of other causes of surgical abdomen because of better visualization. Therefore Zenon Pogorelic [2], Matthew J. Snyder [8], Yu Liu [14] and us recommended laparoscopic appendectomy despite the increased operative time.

Julia Singer [3] suggested that CT scan is helpful in differentiating AA which needs surgery from Typhlitis in cancer patients receiving chemotherapy which needs conservative treatment with IV antibiotics, also Zhi-hua Wang [12] recommended CT scan in obese patients with suspected AA to avoid missed diagnosis because U/S not helpful in obese patients, on the other hand Chih C. Luo [10] identified that the annual increase in the incidence of preoperative CT scan (increased from 3% to 20% over decade) to decrease the incidence of negative appendectomy may be harmful because CT scan takes longer time and this may increase the risk of perforation in young children, at QRHC CT scan is not routinely requested rather it is used in questionable cases.

Despite AA is common worldwide but still there is no universal consensus about selection of antibiotics, dose, route and duration for complicated and non complicated appendicitis [4]. Qingjuan Shang [4] demonstrated that there was no clinical effect of adding metronidazole to broad spectrum antibiotic post perforated appendectomy with regards to post operative duration of antibiotics and complications (abdominal abscess and wound infection), inflammatory variables and hospital stay claiming that anaerobic bacteremia episodes are rare in pediatrics, while at our hospital we give prophylactic dose antibiotic at induction followed by post op antibiotics for 24-48 hours for acute suppurative gangrenous appendix while post perforated appendectomy, we use double therapy (metronidazole and broad spectrum antibiotic) or triple therapy for 3-5 days until normalization of patient temperature, physical examination and WBC and resuming feeding tolerance.

There are diversity in the management of appendicular abscess in literature either by immediate appendectomy or nonsurgical with IV antibiotics alone or with percutaneous drainage followed by interval appendectomy [15].

Chih C. Luo [15] found that treating appendicular abscess with IV antibiotics and percutaneous drainage associated with lower rate of recurrent appendicitis, decreased need for interval appendectomy and fewer post interval appendectomy complications than with IV antibiotics alone without percutaneous drainage. Also he reported that older children (>13 years) have smaller need for interval appendectomy than younger children (<6 years) claiming that it is easier technically to perform percutaneous drainage for older children than younger ones. We apply the same in treating appendicular abscess with IV antibiotics and percutaneous drainage followed by interval appendectomy for patients who develop recurrent appendicitis.

Le-Wee Bi [16] recommended avoidance of routine peritoneal irrigation with normal saline intraoperatively for perforated appendix claiming absence of significant differences in the incidence of postoperative intra abdominal abscess, surgical site infection and length of hospital stay with or without peritoneal irrigation of perforated appendix, while at our hospital we still do peritoneal irrigation for perforated appendix that resulted in diffuse abdominopelvic abscess.

Matthew J. Snyder [8] suggested that the use of clinical and laboratory findings associated with U/S decreased the need of CT scan for the diagnosis of AA, we also apply the same policy at our hospital and request CT scan for only questionable cases, also Ahmet S. Yazar [11] mentioned that the use of Alvarado score and U/S is more effective and accurate for the diagnosis of AA than U/S alone.

Yao Zhang [5] found that pediatric AA is associated with weather factors mainly high temperatures (20-30c), low humidity and less sunshine. He reported in his study that the highest incidence of AA was in summer and autumn claiming that the cause was the association of AA with viral infection which has seasonal epidemics. This wasn't applicable in our study where there was no significant difference between seasons.

CONCLUSION

Acute appendicitis is the commonest cause of abdominal surgical emergency in pediatrics and a common cause of misdiagnosed surgical emergency in children.

The diagnosis of acute appendicitis is challenging because of the difficulty in obtaining a clear history from pediatrics as the child (especially younger than 5 years) cannot express or communicate well and not cooperative during physical examination in addition to the similarity of signs and symptoms of AA with other diseases and the atypical presentation in children.

Delayed diagnosis can result in serious complications as perforation, peritonitis, septicemia, intra-abdominal abscess and intestinal obstruction therefore accurate diagnosis and prompt treatment are mandatory to avoid these morbidities.

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