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Acute appendicitis in infants

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ABSTRACT

Acute appendicitis is very uncommon in the first year of life and often its presentation is atypical with high risk of complications. Hereby, we present 4 clinical cases of infants, who were diagnosed with acute appendicitis in our hospital over the last year. The reported clinical cases highlight the several drawbacks clinicians face when managing infants with symptoms suggestive for acute appendicitis. After specific diagnostic work-up, even if not conclusive, patients were intraoperatively diagnosed with acute appendicitis and underwent appendicectomy. Maintaining a high index of suspicion for acute appendicitis in infants presenting with intra-abdominal sepsis of unclear etiology is, in our opinion, the most crucial factor to avoid complications and longer hospitalization.

Acute appendicitis (AA) is one of the most common causes of surgical admission to the Emergency Department (ED) in pediatric age [1]. It affects more commonly males than females, with a ratio of 1.4:1 [2]. The diagnosis of AA is less common in patients <5 years and very rare in infancy [3]. Indeed, the incidence of AA in infants has been reported about 0.38% [4], accounting for only 2% of all the cases of appendicitis [5]. Due to the unfrequented and atypical presentation of AA in infants, very often these patients face delayed diagnoses with an increase rate of related complications [6]. We hereby present 4 clinical cases of infants which were diagnosed with AA in our hospital over the last year.

1. Case report presentation

1.1. Case report 1

A 6-month old boy with a story of low birth weight (1.840 kg) and hospitalization in neonatal intensive care unit for 24 days for respiratory distress, was admitted at the ED with a 2-day history of fever, vomiting and loss of appetite. At physical examination he presented pallor, irritability and abdominal distention with no signs of peritonitis. Neurological examination was normal. Laboratory data showed wight blood cells (WBC) 11.77 × 10^3/μl3 of which 74% neutrophils and 22.8% lymphocytes, hemoglobin 9.3 g/dl, platelets 640,000 × 10^3/μl3, quantitative C-reactive protein (CRP) 220 mg/L (normal values < 5), procalcitonin (PCT) 18.38 ng/ml (normal values < 0.5), normal coagulation profile, serum albumin 4.2 g/dl, detection of proteins and ketones at urine stick. In the

Abbreviations: AA, Acute appendicitis; ED, Emergency Department.

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suspicion of sepsis, he was hospitalized and ceftazidime and fluid therapy were started. Chest x-ray study was negative for infectious etiologies. Seven hours after admission he started vomiting. On physical examination, his abdomen was distended but soft and palpation revealed right-sided tenderness. Abdomen ultrasound (US) exam showed only multiple enlarged mesenteric lymph nodes [7]. Fourteen hours later the infant had increasing episodes of vomiting, persistent irritability, loss of appetite and constipation. Repeated abdomen ultrasound exam was normal except for low quantity of fluid among the intestinal loops. Abdominal x-ray study showed mild gaseous distension of multiple bowel loops that required surgeon consultation, nasogastric tube placement and urgent referral to the Surgical Unit. A second abdominal x-ray study was unchanged after 8 hours while new abdomen ultrasound exam showed a focal 10-mm, not compressible hyperemic structure in the right lower quadrant. Therefore the infant received an exploratory laparoscopy demonstrating a perforated appendicitis with peritonitis (Fig. 1).

1.2. Case report 2

A 11-month old girl was admitted to our ED due to persistent fever and acute onset of vomiting. She had a story of low birth weight (1.130 g) and on her 7th day of life developed necrotizing enterocolitis, which led her to a 3 cm intestinal resection with transverse colostomy creation. At 1 year of age she received a termino-terminal anastomosis with intestinal recanalization and was doing well as outpatient. At the time of admission to our ED, her mother reported that she has showed food vomiting and fever for about 24 hours. She had not been evacuating for 2 days, while the diuresis was active. Clinical examination revealed a soft, non-distended but apparently painful abdomen. Laboratory test showed abnormal inflammatory parameters (CRP 194 mg/L and PCT 28 ng/ml) along with normal WBC count (9000/μL). She underwent abdominal x-ray and ultrasound evaluation, which allowed to observe in subhepatic region and right iliac fossa uneven thickening and hyperechogenicity of the peritoneal adipose cells with contextual reactive lymph nodes with 19 mm maximum diameter and liquid corpuscular infiltrating flap with some overdistended intestinal loops. Following a clinical worsening, the patient underwent appendicectomy with the finding of a perforated gangrenous appendix (Fig. 2).

1.3. Case report 3

A 3-month old girl was admitted to our ED since she had showed loss of appetite, vomiting and low-grade fever over the last week. She had not been evacuating for 3 days but the diuresis was active. Her mother denied previous clinical problems. At clinical examination she had a soft-distended abdomen, fever and irritability. Laboratory test showed abnormal inflammatory parameters (CRP 97 mg/L) along with normal WBC count (10,000/μL). The first abdomen ultrasound exam showed an image of suggestive ileo-colic in-

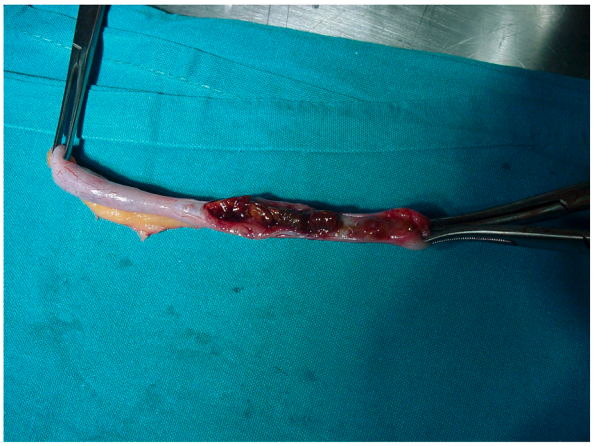

Fig. 1. Perforated appendix after dissection.

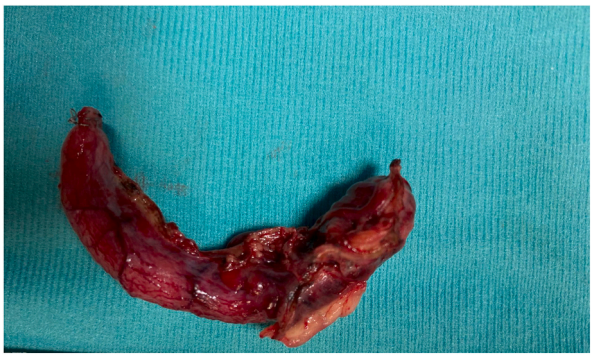

Fig. 2. Perforated gangrenous appendix.

tussusception for which she was referred to the Surgical Unit. However, a subsequent abdomen ultrasound before the laparoscopic surgical intervention showed loops thickening and hyperechogenicity of the peritoneal adipose cells and a non detectable appendix. She underwent laparoscopy with the finding of a perforated gangrenous appendix who was removed.

1.4. Case report 4

A 5-month old girl was admitted to the ED of our hospital referred from a suburban hospital for persistent crying from likely abdominal pain. She was delivered at 29 weeks' gestation and a magnetic resonance imaging at her 4th week of life showed hypoxic outcomes with periventricular leukomalacia and germinal matrix hemorrhage. Until the day before, she was on cefpodoxime for urinary tract infection by *Klebsiella*. She had a previous hospitalization for sepsis at the age of 3 months.

She was taken to the hospital at midnight and her mother reported forceful vomiting since the afternoon along with diarrhea. She was apiretic but had showed little appetite and oliguria over the last yours. Clinical examination revealed fair general clinical conditions with valid crying, flat front fontanel, absence of meningeal signs and regular cardiorespiratory activity. She had a soft, nondistended and apparently painless abdomen. Rectal examination with tube didn't show blood or mucus presence. Laboratory test showed normal inflammatory parameters (CRP 0.07 mg/L) along with normal WBC count (16.400/μL). Abdominal x-ray and ultrasound revealed marked and widespread gaseous distension of the abdominal loops with a faded rounded image (cockade image) in right iliac region, 11 mm in diameter, slightly layered, hypoechoic, likely to be referred to a fleeting intestinal invagination. Due to this suspicion, the patient was referred to our surgeons. At admission, she underwent a new ultrasound examination which excluded the presence of intestinal invagination. Nevertheless, over the next few days lab test showed increased inflammatory markers and ultrasound revealed a persistent intestinal formation in the right para-umbilical region, about 20 mm long with thickened, hyperemic walls, less evident parietal stratification and margins blurred by inflammation, associated with thickening and hyperechogenicity of the omental adipose tissue in the medium-low quadrants with moderate corpuscle liquid flap adjacent to the formation as well as in the various recesses (Fig. 3, Fig. 4). A new x-ray pointed out some hydro-air levels in the mesoaddomen region with upstream distension of the intestinal loops in mesogastrium and left hypochondrium region.

Following a clinical worsening and a further increase of inflammatory markers (CRP 155 mg/L, PCT 10.9 ng/ml) the patient was brought to the operating table underwent appendicectomy with the finding of a perforated gangrenous appendix.

2. Discussion

The reported clinical cases highlight the several drawbacks clinicians face when managing infants with symptoms suggestive for AA. One of the most challenging aspects of infantile AA is making a proper and timely clinical diagnosis. Often, in this age group clinician suspects other more common conditions presenting with the same clinical signs and symptoms of AA [8], like ileal invagination, necrotizing enterocolitis, intestinal obstruction and gastroenteritis.

The diagnostic delay of infantile AA is likely related to the absence of typical symptoms usually seen in older children. Appendicitis in infants may presents with a variety of symptoms that should alert the clinician to an abdominal source, although most of them are non-specific. In patients less than three years the finding of abdominal pain has been documented in a variable proportion of 35–81% of cases [9]. Diarrhea is found in 30–40%, thus being gastroenteritis the most common misdiagnosis in this age group [8]. Other non-specific symptoms frequently associated with AA include fever, feed refusal and marked irritability. Two/3 infants in our series presented with fever while in one case infant reported diarrhea. A recent study showed that fever and diarrhea were very common risk factors of a delayed diagnosis of AA, suggesting other diagnosis like gastroenteritis or other infectious diseases [10]. Attention should be pay in infants with this symptoms, especially if symptoms change during the examination course. Moreover, concurrent upper respiratory symptoms are common and may often confound the presentation [8].

Physical examination findings may vary widely, being irritability sometimes the only sign. Infants may lie still, appear withdrawn and may be tachycardic or tachypneic, secondary to dehydration [10]. A few specific clinical signs associated with infant appendicitis

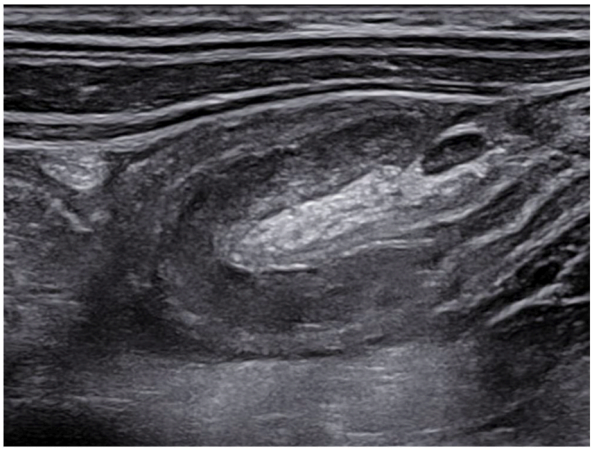

Fig. 3. Ultrasound image showing loops thickening and hyperechogenicity of the peritoneal adipose cells and a non detectable appendix.

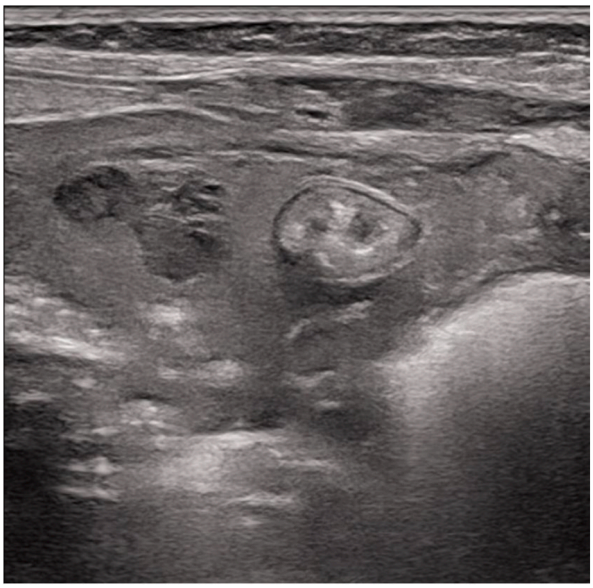

Fig. 4. Ultrasound image demostrating an intestinal formation in the right para-umbilical region of about 20 mm longer with thickened walls, decreased of parietal stratification and around inflammation.

are reliable if present, though are very uncommon: focal right lower quadrant or iliac fossa tenderness, hardening over the right side, palpable mass in the right abdomen or erythematous and firm right hemiscrotum.

Abdominal radiography is routinely performed in case of infant with symptoms suggesting acute abdomen. The study is often non-diagnostic, though may demonstrate findings consistent with other intra-abdominal pathologies or complications such as intestinal obstruction or free air. An abdominal US is also usually performed. US is the preferred initial imaging study for evaluation of appendicitis in the pediatric population due to its high specificity (>90%) and positive predictive value (98%), as well as its lack of exposure to ionizing radiation [11]. However, its highly variable sensitivity (40–90%) is a result of operator-dependent abilities to visualize both inflamed and normal appendices [12,13]. Ultrasound of the appendix in infants is further complicated by a number of issues that make visualizing the appendix more difficult and that potentially limit diagnostic accuracy of the methodic even when the appendix is identified.

When US findings are inconclusive in an infant with acute abdomen, the appropriate next step in the diagnostic workup can be difficult to determine. In older children, the combination of US followed by computed tomography (CT) has been found to be the most effective strategy for diagnosing appendicitis, although it is unclear how well this can be extrapolated to infants [14]. A recent study showed that, especially in younger patients, CT was able to reduce the rates of negative appendectomy [15]. Nevertheless, the risks related to the exposure of infants to ionizing radiation cannot be ignored.

Blood tests in infants with suspected AA can often show unspecific results [16,17]. Increased CRP values may be particularly indicative of complications such as appendix perforation and abscesses. Procalcitonin has proved to be inadequate for the diagnosis of appendicitis, being both its sensitivity and specificity lower than CRP and WBC [18].

Despite their rare frequency, episodes of appendicitis in infants always appear severe and often complicated. This could probably be related to the relatively thin thickness of the organ walls, which imply a greater probability of perforation, and to a still incomplete maturation of the immune system [19]. It has been hypothesized that the reduced extension of the omental tissue makes it more difficult to effectively surround the inflammatory process in order to "isolate" the inflammatory process [20]. As a consequence, perforation of appendix often leads in these patients to the development of a "pseudotumoral" mass whose etiology is often difficult to identify. In this circumstance the appendix cannot even be recognized by ultrasound because it is often completely destroyed by the inflammatory process. Therefore, the anatomical conformation together with the possibility to have a negative US at the beginning and difficulties of history taking and physical examination in infants make the diagnosis of AA in infants often delayed. Diagnostic delay can result in perforation, abscess formation, postoperative complications and long hospital stay, so should be avoid. In this context if there is a high level of suspicion for appendicitis, consultation with a pediatric surgeon is warranted; antibiotics, gastric decompression, intravenous fluids, and pain control should be than timely administered.

3. Conclusion

In conclusion, AA is a rare but potentially life-threatening condition in infants. It has routinely an atypical presentation that is commonly missed on the initial assessment. The diagnosis of appendicitis as the etiology of abdominal pain in infants is challenging and largely clinical, with no pathognomonic laboratory tests available. Early imaging findings may be normal in many patients or may diagnose constipation as the etiology of the abdominal pain. Non-visualization of the appendix by a radiologist does not rule out appendicitis, with serial ultrasound examinations increasing the likelihood of the diagnosis. Very often the appendiceal involvement

is identified only after an exploratory surgical intervention, with increase rates of morbidity and mortality. Innovation in high-resolution US and CT techniques, along with improved minimally invasive approaches, may be expected to reduce the rates of complications. However, maintaining a high index of suspicion for appendicitis in infants presenting with intra-abdominal sepsis of unclear etiology is, on our opinion, the most crucial factor to avoid complications and longer hospitalization. Therefore it is mandatory for a physician to recognize the possibility of appendicitis also in an infant with no initial suspicion of abdominal involvement and with systemic symptoms of no other origin, and to evaluate the possibility of repetitive US and a pediatric surgeon consultation in order to not misdiagnose the appendicitis in this age group.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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