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Clinical Paper

Diagnostic accuracy of ultrasound in the paediatric population with acute right iliac fossa pain, our District General Hospital experience.

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Abstract

Aim

This project aimed to evaluate the role of ultrasound scan (USS) in children presenting with acute onset right iliac fossa (RIF) pain and suspected appendicitis

Methods

We retrospectively studied 100 consecutive children undergoing USS for RIF pain. Children with low to moderate clinical probability of appendicitis were seen by the surgical team and subsequently underwent USS by a radiologist or a sonographer with a special interest in paediatric USS. The clinical findings, blood tests, and radiological diagnosis led to a decision to operate, observe or discharge. USS findings were subsequently verified with the final histology. The six-month follow-up data of these patients were also analysed.

Results

35 males, median age of 11 years (range 4-17), and 65 females, median age of 14 years (range 6-18) were included. A total of 23 appendicectomies were performed. On histology appendicitis was confirmed in 20, including 16 pre-operatively diagnosed on USS. 6 of these appendicectomies were performed on clinical suspicion with normal USS. 1 patient was diagnosed with neuroendocrine tumour of the appendix. Only 2 negative appendicectomies were performed. 62 patients were discharged without intervention. USS sensitivity was 74%, and specificity was 92% for appendicitis. An additional 16 patients were identified with alternate pathology including 5 ovarian cysts.

Conclusion

Appendicitis was more common in male patients; however, there was no difference in overall disease prevalence in male or female paediatric patients. Thus, USS is a valuable tool to exclude appendicitis in children with low to moderate probability.

Introduction

The lifetime prevalence of appendicitis is around 7%. In the UK, 12,000 appendicectomies are performed every year for children under the age of 18 years, and 80% of these cases are managed in district general hospitals[1,2] Acute right iliac fossa pain is a common presentation in children attending the emergency department. Diagnosis of acute appendicitis in children remains a challenge as there may be symptom overlap mimicking other differentials such as mesenteric adenitis, gastroenteritis, ovarian cyst, and urinary tract infections. Effective clinical assessment and ultrasound scan (USS) help identify patients who require surgical intervention. The classic symptoms of abdominal pain, nausea, vomiting, anorexia, and shifting of pain occur in less than 50% of cases[3]. Similarly, typical signs of tenderness, rebound tenderness, and peritonitis may not be present until there is a severe infection, perforation, or the presence of an abscess. USS is a widely available and preferred method to help diagnose appendicitis in children. Computed tomography (CT) scanning is, however, thought to be more sensitive[4]. The use of CT scans in children is limited because of the risk of radiation. With this, we looked into the diagnostic practice of our department in a medium-sized district general hospital.

Methods

In this retrospective study, a total of 100 children who presented to the emergency department with right iliac fossa pain between January and December 2019 were included. Histology and 6-month follow-up data were also assessed. All children included were seen by a senior member of the on-call team (a registrar or a consultant), underwent routine blood tests, and USS by a radiologist or a sonographer with a special interest in paediatric USS. Children with a high index of suspicion of appendicitis who did not require USS and directly underwent surgery were excluded from this study. Data was collated into an Excel spreadsheet and analysed for frequencies, sensitivity, and specificity.

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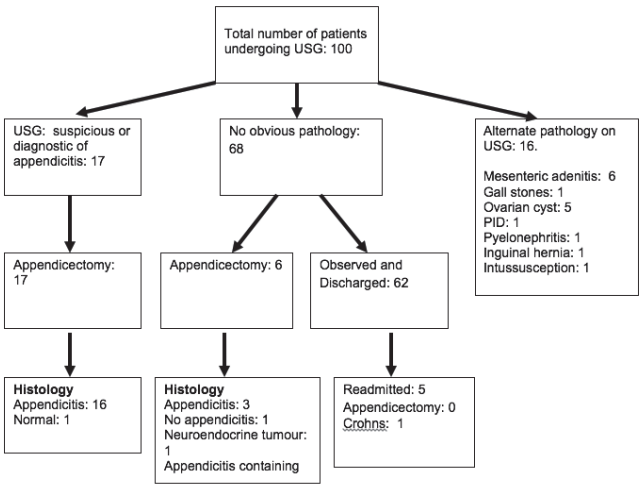
Results

Table 1: Age ranges for this cohort of patients

Pathology	Male (total 35)	Female (total 65)
Appendicitis	9(28%)	12(18%)
Mesenteric adenitis	3	3
Ovarian cyst	NA	5
Gall stones	1	0
Urinary Tract Infection	0	1
Pelvic Inflammatory disease	0	1
Possible Intussusception	1	0
Small groin hernia	1	0
Crohn's disease	0	1
Neuroendocrine tumour	0	1
Total	**15 (42%)**	**24 (37%)**

Table 2: Frequencies of pathology identified and treated in our cohort of patients on USS and final histology.



This study included 35 males, 65 females, and their median age was 14 years (range 4-18, table 1 shows age ranges). A total of 20 patients had a final diagnosis of appendicitis on histology, including 8 males and 12 females. Disease prevalence in these symptomatic children with right iliac fossa pain was similar (male 40%: female 37%). 16 of 20 histology proven appendicitis were diagnosed pre-operatively on USS with corresponding sensitivity of 74%. 62 patients with normal USS did not require intervention and were discharged, and the related specificity of USS was 92%. 6 additional appendectomies were performed based on clinical concerns, 4 of which were positive for appendicitis including one containing worms. 1 patient was diagnosed with neuroendocrine tumour on histology. In addition, 16 alternate pathologies were recognised, including 5 patients with ovarian cysts. Only 2 negative appendicectomies were performed in this cohort. (For details see Table 1, 2 below and Figure 1 in the appendix).

Discussion

Appendicitis is the commonest presentation with right iliac fossa pain in children and adolescents[5]. Prevalence of appendicitis in children referred for imaging investigations is reported between 31-50%[6]. Complexities in examination and communication issues in children could limit the clinical diagnostic accuracy and result in incorrect diagnosis in 28-57%[6] cases. Delayed diagnosis could result in perforated appendicitis, which could be as high as 51% amongst patients younger than 5 years. This may be secondary to limitations of communication and expression in the history and description of symptoms. However, the rate of perforated appendicitis improves in adolescents.[5] Adolescents present earlier and elicit more typical signs and symptoms.[6] Perforated appendicitis can lead to complications, extended length of stay in the hospital, and increased risk of mortality; therefore, early diagnosis and management is emphasised.[5,7] It is recorded that a treatment delay of 36 hours could result in perforated appendicitis in 65% of children.[6] In females, it is difficult to distinguish between appendicitis and gynaecological disorders therefore; they are more likely to have a negative appendicectomy[6,8].The prevalence of appendicitis in our cohort was slightly low compared to the published data. The prevalence of appendicitis was high in males, whereas teenage girls were found to have alternate pathology such as an ovarian cyst. The overall prevalence of pathology was similar in both groups 40% vs. 37%.

In addition to the clinical assessment, blood tests such as white cell count, neutrophil count, C reactive protein are commonly used to help diagnose. The predictability of the diagnosis can be improved by combining clinical assessment and blood tests. This is also the basis of commonly used scoring systems such as the Alvarado score for appendicitis. There is variable data for its sensitivity (75-90%) though it has been widely used since 1986.[9-10] The emphasis is on early recognition and treatment of appendicitis; this will reduce complications such as perforation and maintain a low negative appendicectomy rate. In the UK, Paediatric Emergency Appendicectomy guidelines recommend that the majority of operations should be performed within 12 hours of decision making and to aim for a negative appendicectomy rate below 15%.[1] Trends of management of appendicitis have slowly changed, however, most cases in the UK continue to be managed in district general hospitals.[1,2]

In some cases, clinicians may opt out of any imaging, and decisions in such cases are direct to surgery based on the clinical signs of frank peritonitis secondary to appendix perforation. We identified 30 additional children during this period, who were clinically diagnosed with appendicitis

and underwent surgery without USS and therefore excluded from this study. Their histology subsequently confirmed the clinical diagnosis. Most of the children presenting with low to moderate probability require imaging for early diagnosis. An early and accurate diagnosis is required in such cases to plan timely treatment and prevent high negative appendicectomy rates.[8] The average waiting time for USS in our cohort was 18 hours in the 'hot clinic' setting and in admitted patients, USS waiting time was 14 hours. In the Netherlands, the negative appendicectomy rate has reduced from 15% to 3.3% after implementation of imaging guidelines before surgery, and similarly, in the United States of America, the Surgical Care and Outcomes Assessment Program (SCOAP) has reduced the negative appendicectomy rate to 5.4%.[11] In accordance with the guidelines and recommendations, in our district general hospital, we have the facility to investigate and treat such children on a regular basis.[1,2] Early assessment, timely and accurate investigations, and treatment resulted in only 2 (10%) negative appendicectomies in our centre. Our 6-month follow-up data did not reveal any additional appendicectomies in this cohort of patients. This data showed 2 patients with post-operative infection, and they were treated conservatively with antibiotics. We referred 3 of our patients to a tertiary centre for further assessment and management, and this included a suspected Crohn's disease, a suspected intussusception, and a patient with post-operative histology suggestive of a neuroendocrine tumour.

USS is a widely used imaging modality in children presenting with RIF pain. The selection of imaging modality may vary in different centres across the world as in some places, CT scan is used as first-line imaging modality; however, in the UK, USS is still considered the first-line imaging modality in children. The sensitivity and specificity of USS in acute paediatric appendicitis are variable; previous studies reported sensitivity and specificity as low as 58-77% and 61-68% respectively.[3,12]. USS however, is an operator-dependent tool, and the results may improve in more experienced hands, in previous literature it was found that a carefully performed USS has a sensitivity of 75-90% and specificity of 90-99%.[12,13] We have a dedicated specialist consultant sonographer with an interest in paediatric USS and a team of sonographers who work closely with the radiologists. Although the sensitivity in our USS department was on the lower end of published data, high specificity helped with the discharge of patients with low to moderate probability.

CT scan is not widely used in the paediatric population because of the perceived risks of radiation and paediatric organ sensitivity to radiation and the cost of CT scans.[12,15] Its reported sensitivity is 90-100% and specificity 91-99%, evidently higher than USS.[13,14] The American College of Radiology (ACR) suggests considering the risk of radiation and suspicion of clinical complexity when making such decisions to expose children to radiation.[15] Reduced dose CT is a better alternate modality and as effective as conventional CT with a sensitivity of 95% and specificity of 94% as described in a recent systematic review and meta analysis. The dose of radiation used is 78% less than a conventional CT in such scans. Magnetic resonance imaging (MRI) is the third choice of imaging in appendicitis. MRI is particularly beneficial in the paediatric population in which CT scanning would be used reluctantly, given the fact that MRI produces no radiation.[15] Its reported sensitivity and specificity are 94-97% and 94-98% respectively.[15] Its use however, is limited because of its unavailability in acute settings and the length of time required (40-45 minutes), although this may significantly be reduced in new generation scans.[12] Similarly, a reduced number of sequences can be applied to reduce the scan time to around 15 minutes.[12] Young children may not tolerate the noise and tunnel effect. Other contraindications include metal implants and loose bodies. Reporting of MRI requires a subspecialist gastrointestinal radiologists, and all these factors limit its use in emergencies. [15] A typical cost comparison reveals that USS is the cheapest modality amongst the 3 available options; however, taking into account the number of days spent in hospital, the negative appendicectomy rate, and potential complications.[12]

Overall, USS is a beneficial and relatively cheap modality of imaging for acute appendicitis in children. In our experience, it has been a helpful aid in diagnosis and, more importantly, in excluding pathology in low to moderate clinical suspicion. Furthermore, dedicated and experienced USS specialists are useful in this regard as in our unit. We, however, appreciate that a stepwise approach including USS as a first-line modality (accepting possible lower sensitivity), followed by low dose CT or MRI if USS is inconclusive, should be considered. However, this depends on the ongoing clinical concern as many clinicians may or may not opt for CT or MRI. Therefore, these decisions are individualised and made based on a risk versus clinical complexity basis.

Conclusion

In children presenting with right iliac fossa pain, clinicians continue to rely on USS because of the diagnostic uncertainty of the presenting complaint. CT and MRI are alternative imaging options. We acknowledge the support of our radiology and surgical department in the management of all these patients.

No conflict of interest or financial support to declare.

Appendix

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