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How do you diagnose appendicitis? An international evaluation of methods

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ABSTRACT

Introduction: Considerable variability exists in the diagnostic approach to acute appendicitis (in children), affecting both quality and costs of care. Interestingly, an international evaluation of what is commonly practiced today has not been performed. We aimed to document current practice patterns in the diagnosis of appendicitis in children and to determine whether a consensus exists in the workup of these patients among Canadian, Dutch, and Saudi Arabian pediatric surgeons.

Methods: We performed a cross-sectional survey using a pre-designed, self-administered, 14-item survey. We sent the survey to participants via electronic mail.

Results: In total, 83 responses were received and analyzed, yielding a response rate of 42%. The majority of respondents practiced at pediatric surgery centers with over 50 beds (58% of Canadian surgeons, 81% of Dutch surgeons, 93% of Saudi Arabian surgeons). The majority of Dutch surgeons had a preference for physical examination and radiological imaging as opposed to Canadian and Saudi Arabian surgeons who favored history and physical examination. Interestingly, only one of the surgeons surveyed used an appendicitis scoring system. Regarding history and physical examination, most respondents deemed migratory abdominal pain and localized RLQ tenderness to be most suggestive of appendicitis. Ultrasound was the most preferable imaging modality in acute appendicitis across all three countries.

Conclusion: This study demonstrates that international pediatric surgeons vary substantially in the diagnostic workup of patients with appendicitis. Furthermore, there is a variability between common practice and the current evidence. We recommend that pediatric surgeons develop clinical practice guidelines that are based on consensus information (expert opinion) and the best available literature.

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1. Introduction

Appendicitis is the most frequent surgical etiology among children with abdominal pain presenting to emergency departments or outpatient clinics.¹ Seventy-seven thousand pediatric hospital discharges each year are for appendicitis and other appendiceal conditions. The costs are estimated to be \$680 million in the U.S. alone.² Distinguishing appendicitis from other abdominal disorders can be difficult, especially in young, preverbal children. Because appendicitis has a variable presentation, depending on the age of the child, the duration of symptoms, and the exact position of the appendix in the abdomen, diagnosis remains

problematic, with the surgeon striving to avoid a negative appendectomy as well as a delay in treatment. These difficulties likely contribute to the 28%–57% rates of initially misdiagnosed appendicitis in children younger than 12 years.^{3–5} In one-third of children with appendicitis, the appendix ruptures prior to operative treatment.⁶ Therefore, evaluation of abdominal pain in children should aim to more accurately identify which children with abdominal pain and likely appendicitis should undergo immediate surgical evaluation for potential appendectomy and which children with equivocal presentations of possible appendicitis may benefit from further investigation.

Considerable variability exists in the diagnostic approach to acute appendicitis in children, affecting both quality and costs of care.⁷ Diagnostic evaluation options range from a simple clinical evaluation, to advanced radiological imaging. Interestingly, evaluation of the current methods used to diagnose pediatric appendicitis has been seldom performed. We aimed to document the

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current practice patterns among Canadian, Dutch, and Saudi Arabian pediatric surgeons in the diagnosis of appendicitis in children and to determine whether a consensus exists in the workup of these patients.

2. Methods

The study was a cross-sectional survey among pediatric surgeons in Canada, The Netherlands, and Saudi Arabia, which took place in March, 2012.

A pre-designed, self-administered, 14-item survey was prepared and sent via electronic mail to members of the Canadian Association of Pediatric Surgeons, members of the Netherlands Association of Pediatric Surgeons, and pediatric surgeons registered with the Saudi Council for Health Specialties. At the beginning of the questionnaire, the purpose of the study was explained.

The survey consisted of multiple choice questions regarding the diagnostic methods used in acute appendicitis in children. Items such as history and physical examination, laboratory investigations, appendicitis scores, and radiological examination were assessed (Appendix 1). Participation was voluntary and no fee for response was offered.

3. Results

In total, 83 responses were received and analyzed, yielding a response rate of 42%. The majority of respondents practiced at large pediatric surgery centers with over 50 pediatric surgical beds (58% of Canadian surgeons, 81% of Dutch surgeons, 93% of Saudi Arabian surgeons.) The majority of Canadian respondents (42%) practiced at high volume centers with over 125 appendectomies yearly. Dutch surgeons had lower volumes with most of the respondents (31%) reporting 75–125 yearly appendectomies. Saudi surgeons had even lower volumes with the majority (57%) reporting 25–75 appendectomies per year. Across all three countries, the majority reported an estimated negative appendectomy rate of less than 5% (81% in Canada, 75% in the Netherlands, 71% in Saudi Arabia.)

When making the diagnosis of acute appendicitis, the two most important determinants were history and physical examination among the majority of Canadian and Saudi surgeons (Table 1).

The majority of Dutch surgeons relied more on physical examination and radiological imaging. Interestingly, only one of the surgeons surveyed used an appendicitis scoring system. Regarding history and physical examination, most respondents deemed migratory abdominal pain and localized RLQ tenderness as most suggestive of appendicitis. 52% of Canadian surgeons felt that an elevated WBC count was the most accurate laboratory indicator of acute appendicitis. Whereas 81% of Dutch surgeons agreed that elevated CRP was more suggestive of acute appendicitis. 57% of Saudi surgeons chose left shift as the most suggestive lab finding.

Table 1

Most preferred diagnostic methods for acute appendicitis among Canadian, Dutch, and Saudi Arabian pediatric surgeons (Respondents were allowed to choose more than one therefore percentages maybe greater than 100%).

	Canada	Netherlands	Saudi Arabia
History	33 (28%)	3 (19%)	6 (43%)
Physical examination	44 (37%)	14 (88%)	10 (71%)
Lab investigations	6 (5%)	2 (13%)	1 (7%)
Appendicitis score	1 (0%)	0 (0%)	0 (0%)
Radiological imaging	18 (15%)	9 (56%)	6 (43%)
Observation & re-examination	15 (12%)	0 (0%)	4 (29%)

Ultrasound was the most preferred imaging modality in acute appendicitis across all three countries. CT was a less popular choice, and plain films and MRI were seldom used (Table 2).

4. Discussion

The differential diagnosis of abdominal pain in children ranges from simple causes, such as constipation, to potentially catastrophic ones, like malrotation with midgut volvulus. Accurately identifying the earliest onset of symptoms is important for promptly evaluating appendicitis and minimizing delays and the risk of perforation. Treatment delayed for more than 36 h increases the perforation rate to as high as 65%.⁸ On the contrary, the reported negative appendectomy rates for some series are as high as 20%. Negative appendectomy rates of 10%–15% have been stated as acceptable to avoid delays in diagnosis possibly leading to increased morbidity from appendiceal perforation. This is especially true in female adolescents, where it can be difficult to distinguish appendicitis from pelvic inflammatory disease and other gynecologic disorders. As a result, girls and women aged 15–24 years are 2.5 times more likely than same-age boys and men to undergo a negative appendectomy.⁹

This puts the pediatric surgeon in a diagnostic dilemma between ‘under-calling’ and ‘over-calling’ acute appendicitis, and therefore makes the diagnostic workup all the more crucial.

History and physical examination are the cornerstones to the approach to pediatric appendicitis. Abdominal pain is a nearly universal symptom of appendicitis in older children, although the history of pain can be difficult to elicit in young children.

The majority of the respondents to our survey deemed that migratory RLQ pain was the most significant finding on history. This is in keeping with a systematic review by Bundy et al.¹⁰ that in level 3 studies, presence of RLQ pain had minimal impact on the likelihood of appendicitis (summary LR, 1.2; 95% CI, 1.0–1.5); absence of RLQ pain, however, did decrease the likelihood (summary LR, 0.56; 95% CI, 0.43–0.73). Presence of pain that began mid-abdominally and migrated to the RLQ was more useful (LR range, 1.9–3.1), while absence of this pain evolution had a similar LR compared to that for the absence of RLQ altogether (LR range for absence of RLQ migratory pattern, 0.41–0.72).

Among all those surveyed, only one respondent, from the Netherlands, felt that fever was the most important sign on physical examination. This is surprising because, the same review¹⁰ found that a fever increases the likelihood of appendicitis by about 3-fold (LR, 3.4; 95% CI, 2.4–4.8) while the absence of a fever lowers the likelihood of appendicitis by about two-thirds (LR, 0.32; 95% CI, 0.16–0.64). Fever was not as useful a symptom in the 4 level 3 studies that evaluated fever.

On Physical examination, RLQ tenderness was felt to be the most important sign among the majority of respondents in all three countries. Rebound tenderness was the second most important sign among Canadian and Saudi Arabian pediatric surgeons, and the third most important among Dutch surgeons. This is ironic due to the fact that upon review of the literature, level 1 data were available for only one sign: localized abdominal tenderness; this sign was not helpful in predicting appendicitis. However, none of the studies quantified the degree of tenderness. We hypothesize that the degree of tenderness is an important clinical sign that should be studied in diagnosis of childhood appendicitis. Rebound tenderness was the most useful sign evaluated in at least three studies. In these level 3 studies, the presence of rebound tenderness tripled the odds of appendicitis (summary LR, 3.0; 95% CI, 2.3–3.9) while its absence decreased the odds by more than two-thirds (summary LR, 0.28; 95% CI, 0.14–0.55).¹⁰

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