



Secondary signs may improve the diagnostic accuracy of equivocal ultrasounds for suspected appendicitis in children



Kristin N. Partain^a, Adarsh Patel^b, Curtis Travers^c, Courtney E. McCracken^c, Jonathan Loewen^d, Kiery Braithwaite^d, Kurt F. Heiss^e, Mehul V. Raval^{e,*}

^a Emory University School of Medicine, Atlanta, GA, USA

^b Emory College, Emory University, Atlanta, GA, USA

^c Department of Pediatrics, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, GA, USA

^d Division of Pediatric Radiology, Department of Radiology and Imaging Sciences, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, GA, USA

^e Division of Pediatric Surgery, Department of Surgery, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, GA, USA

ARTICLE INFO

Article history:

Received 14 January 2016

Accepted 4 March 2016

Key words:

Pediatric surgery

Appendicitis

Secondary signs

Ultrasound

Quality improvement

ABSTRACT

Introduction: Ultrasound (US) is the preferred imaging modality for evaluating appendicitis. Our purpose was to determine if including secondary signs (SS) improve diagnostic accuracy in equivocal US studies.

Methods: Retrospective review identified 825 children presenting with concern for appendicitis and with a right lower quadrant (RLQ) US. Regression models identified which SS were associated with appendicitis. Test characteristics were demonstrated.

Results: 530 patients (64%) had equivocal US reports. Of 114 (22%) patients with equivocal US undergoing CT, those with SS were more likely to have appendicitis (48.6% vs 14.6%, $p < 0.001$). Of 172 (32%) patients with equivocal US admitted for observation, those with SS were more likely to have appendicitis (61.0% vs 33.6%, $p < 0.001$). SS associated with appendicitis included fluid collection (adjusted odds ratio (OR) 13.3, 95% confidence interval (CI) 2.1–82.8), hyperemia (OR = 2.0, 95%CI 1.5–95.5), free fluid (OR = 9.8, 95%CI 3.8–25.4), and appendicolith (OR = 7.9, 95%CI 1.7–37.2). Wall thickness, bowel peristalsis, and echogenic fat were not associated with appendicitis. Equivocal US that included hyperemia, a fluid collection, or an appendicolith had 96% specificity and 88% accuracy.

Conclusion: Use of SS in RLQ US assists in the diagnostic accuracy of appendicitis. SS may guide clinicians and reduce unnecessary CT and admissions.

© 2016 Elsevier Inc. All rights reserved.

1. Background

Despite appendicitis representing the leading cause of pediatric abdominal pain requiring emergent surgery, the clinical diagnosis remains challenging. Diagnostic imaging is often required, and its use has dramatically decreased the negative appendectomy rate [1]. Ultrasound (US) of the right lower quadrant (RLQ) is recommended by the American College of Radiology and the American Academy of Pediatrics as the initial imaging modality in evaluating pediatric appendicitis [2,3]; however, there is wide variation in the use of diagnostic imaging [4–7]. US provides a safe, non-invasive option that avoids radiation exposure while providing useful diagnostic information [8–11]. The user-dependency of US is reflected by a wide appendix visualization rate

ranging from 40% to 89% [12–16]. Furthermore, differences in intra-institutional appendix visualization rates exist depending on whether the study is performed by a pediatric radiologist or a pediatric radiology technologist (75% vs 54%) [17]. When the appendix is visualized, US typically has a sensitivity (SN) ranging from 86% to 100% and specificity (SP) ranging from 88% to 98% [1,10,13,18].

US studies that fail to fully visualize the appendix are considered equivocal and are often followed by computed tomography scans (CT) or hospital admissions for observation [19]. CTs are an accurate diagnostic tool with reports of SN ranging from 95% to 97% and SP ranging from 94% to 97% [1]. In addition to the expense of CTs, CTs expose children to ionizing radiation, increasing their risk of subsequent cancer development [9,20–22]. In effort to increase the diagnostic accuracy of US, investigators have proposed combining equivocal US studies with additional data such as laboratory values or sonographic secondary signs of appendicitis [16,17,23–25]. These results have not been widely validated, and the clinical utility of secondary signs has not been generally accepted.

Secondary signs are sonographic descriptions of the anatomy of structures surrounding the appendix and include fluid collections,

Abbreviations: CT, Computed tomography; NPV, Negative predictive value; PPV, Positive predictive value; RLQ, Right lower quadrant; SN, Sensitivity; SP, Specificity; SS, Secondary signs; US, Ultrasound.

* Corresponding author at: Division of Pediatric Surgery, Department of Surgery, Emory University School of Medicine, Children's Healthcare of Atlanta, 1405 Clifton Road NE, Atlanta, GA 30322. Tel.: +404 785 0781; fax: +404 785 0800.

E-mail address: mehulvralav@emory.edu (M.V. Raval).

free fluid, echogenic fat, hyperemia, abnormal lymph nodes, abnormal adjacent bowel, bowel wall edema, and appendicoliths [11,23]. The purpose of our study is to evaluate if the use of secondary signs in equivocal US reports improves the diagnostic accuracy of US for pediatric appendicitis.

2. Methods

2.1. Patient selection

After obtaining approval from the Emory University Internal Review Board (#00,077,519), we performed a retrospective chart review for patients (ages 5–18 years) who presented to one of two pediatric emergency departments of a university-affiliated tertiary care facility between January 1, 2014 and December 31, 2014. The initial cohort was identified using language recognition software to examine the chief complaints as listed in the electronic medical record. Search terms included: *abd*, *appy*, *stomach*, *appendicitis*, and *rlq*. The key word search identified 10,320 visits. Patients were included if they had concern for appendicitis and received a RLQ US that evaluated the appendix. Patients were excluded if they underwent an US or CT for their abdominal pain at an outside hospital, if they had a history of an

appendectomy, if they were currently being non-operatively managed for appendicitis, or if they did not have abdominal pain (Fig. 1A).

2.2. Variables and outcome definitions

Final US reports were reviewed by two authors (KP, AP) for primary and secondary signs of appendicitis. The primary sign of appendicitis was a fully visualized appendix with a diameter greater than or equal to 6 mm²³. Secondary signs included fluid collections consistent with abscesses (fluid collections), a significant amount of abdominal free fluid (free fluid), hyperechogenicity of periappendiceal fat (echogenic fat), increased regional bowel vascularity (hyperemia), the presence of enlarged or supranumery mesenteric lymph nodes (abnormal lymph nodes), hypoperistalsis or dilation of adjacent bowel loops (abnormal adjacent bowel), bowel wall edema, and appendicoliths [11,23]. As has been previously described, US reports were classified into four categories: 1. normal; 2. equivocal without SS; 3. equivocal with SS; and 4. appendicitis [23,24,26]. Categories 1 and 4 included a fully visualized appendix and were collectively referred to as unequivocal. Categories 2 and 3 included US in which the appendix was not fully visualized and were collectively referred to as equivocal. The final diagnosis of each patient was recorded as either appendicitis or not appendicitis as shown in Fig. 1B. Appendicitis was confirmed through review of

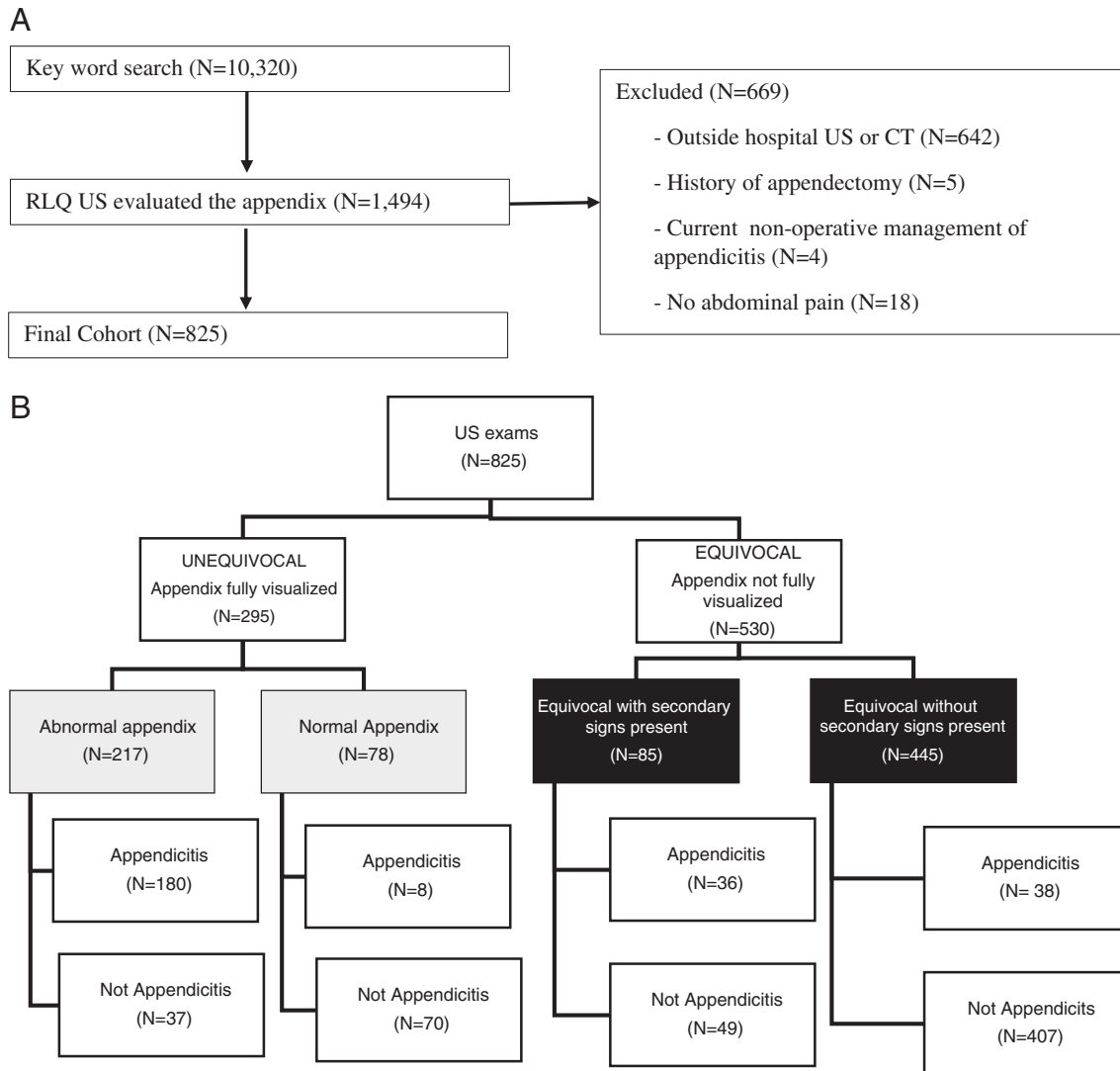


Fig. 1. (A) Inclusion and exclusion of patients being evaluated for appendicitis who underwent a right lower quadrant (RLQ) ultrasound (US) in 2014 at a tertiary care children's referral center. (B) US classification and confirmed diagnosis of the patients in the included cohort.

Download English Version:

<https://daneshyari.com/en/article/4154675>

Download Persian Version:

<https://daneshyari.com/article/4154675>

[Daneshyari.com](https://daneshyari.com)