

**Original article:**

## **Evaluation of Emergency Department Ultrasound for Acute Appendicitis: A Retrospective Analysis**

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Date of Submission: 02 November 2010, Date of Acceptance: 12 December 2010

### **ABSTRACT**

**Background:** Acute appendicitis remains one of the most common presentations of acute abdominal pain in both adults and children. The present retrospective study was conducted to evaluate emergency department ultrasound for acute appendicitis.

**Materials and Methods:** The present retrospective study was conducted to assess all the patients that were admitted with the chief problem of appendicitis. Patients which were admitted in whom right lower quadrant (RQ) abdominal ultrasounds performed were included in the study. Only those cases were included in this retrospective analysis in which confirmation of the diagnosis was given. The recorded data was compiled, and data analysis was done using SPSS (SPSS Inc., Chicago, Illinois, USA).

**Results:** A total of 200 ultrasounds were performed for the problem of appendicitis. A total of 32 patients showed positive results for bedside ultrasound for appendicitis (BA). Out these 32 patients, 19 were affected by appendicitis while in 13 patients, appendicitis was absent. A total of 155 patients were reported to be BA negative. Out of them in 52 and 103 patients, appendicitis was present and absent, respectively. In total, out of 200 total patients, 84 cases showed presence of appendicitis while in 116 cases, appendicitis was absent. Prevalence in the present study was found to be 0.44 while the specificity and the sensitivity were found to be 0.91 and 0.42 respectively. Positive predictive values and the negative predictive values were found to be 0.75 and 0.67 respectively.

**Conclusion:** The present study concluded that a total of 32 patients showed positive results for bedside ultrasound for appendicitis (BA). Out these 32 patients, 19 were affected by appendicitis while in 13 patients, appendicitis was absent. A total of 155 patients were reported to be BA negative. Out of them in 52 and 103 patients, appendicitis was present and absent, respectively.

**Key words:** Bedside Ultrasound for Appendicitis (BA), Specificity, Sensitivity, Positive Predictive Values, Negative Predictive Values.

### **INTRODUCTION**

Acute appendicitis (AA) results from inflammation of the appendix and is among the most common causes of acute abdominal pain that requires surgery, occurs in 7% of the population, with peak incidence age 10 – 30.<sup>1-3</sup> In patients with acute appendicitis, the primary complaint is pain in abdominal area. The diagnostic pattern of colicky central abdominal pain followed by vomiting with shifting of the pain to the right iliac fossa was first described

by Murphy but it may only present in 50% of cases.<sup>4</sup> Peri-umbilical colicky pain is the description of the typical pain as reported by the affected patients which further intensifies during the first 24 hours, becoming constant and sharp, and migrates to the right iliac fossa.<sup>3,5</sup>

Visceral innervation of the midgut results in the referred pain or the initial pain. Loss of appetite, constipation, nausea, and profuse vomiting are other common symptoms encountered in such patients.<sup>6</sup> Despite the advancements in the diagnostic technologies and clinical strategies, still false positive and false negative results in making the diagnosis of acute appendicitis are significantly reported.<sup>7</sup> Physicians generally prefer to use laboratory tests and ultrasound (US) for the initial evaluation of patients with low pretest probability for AA. US is a noninvasive and reproducible diagnostic tool that does not require any contrast agent nor radiation exposure. Nonetheless, it is an operator-dependent method. The sensitivity and specificity of US for the diagnosis of AA are reported as being between 75 to 90 and 86% to 95%, respectively.<sup>8,9</sup> The present retrospective study was conducted to evaluate emergency department ultrasound for acute appendicitis.

## **MATERIALS AND METHODS**

The present retrospective study was conducted to assess all the patients that were admitted with the chief problem of appendicitis. Patients which were admitted in whom right lower quadrant (RQ) abdominal ultrasounds performed were included in the study. The involved EDs had training in the diagnosis and treatment of the lesions of the gall bladder, aorta, cardiac region, pelvis etc. but didn't have much exposure to appendicitis.

A 200 ultrasounds were performed by the EDs which included in the study. Only those cases were included in this retrospective analysis in which confirmation of the diagnosis was given team of Radiologists. No additional information and hands-on instruction were given to the ED regarding the technique of ultrasound. Non-compressible RLQ tubular structure of at least six millimetres was the whole and sole primary sonographic criterion for the EDs for arriving to the final diagnosis of appendicitis. Other features and sonographic findings which were excluded from the list of primary criteria and were included under the category of secondary features included: Appendicolith, Extraluminal fluid collections, Hyperemia on color flow Doppler, Interruption of the echogenic submucosa. The recorded data was compiled, and data analysis was done using SPSS (SPSS Inc., Chicago, Illinois, USA).

## **RESULTS**

A total of 200 ultrasounds were performed by the EDs for the problem of appendicitis. A total of 32 patients showed positive results for bedside ultrasound for appendicitis (BA). Out these 32 patients, 19 were affected by appendicitis while in 13 patients, appendicitis was absent. A total of 155 patients were reported to be BA negative. Out of them in 52 and 103 patients, appendicitis was present and absent, respectively. In total, out of 200 total patients, 84 cases showed presence of appendicitis while in 116 cases, appendicitis was absent. Prevalence in the present study was found to be 0.44 while the specificity and the sensitivity were found to be 0.91 and 0.42 respectively. Positive predictive values and the negative predictive values were found to be 0.75 and 0.67 respectively.

**Table 1: Distribution of patients**

	Appendicitis		
	Present	Absent	Total
<b>BUSA positive</b>	32	13	45
<b>BUSA Negative</b>	52	103	155
<b>Total</b>	84	116	200

**Table 2: BU accuracy**

BA's accuracy	Point estimate	95 percent Confidence interval	
<b>Prevalence</b>	0.44	0.39	0.54
<b>Sensitivity</b>	0.42	0.27	0.53
<b>Specificity</b>	0.91	0.80	0.96
<b>Positive predictive value</b>	0.75	0.56	0.87
<b>Negative predictive value</b>	0.67	0.55	0.75

## DISCUSSION

Approximately 3.4 million patients per year present to EDs in the United States with a chief complaint of abdominal pain,<sup>10</sup> of which 250,000 (7%) are diagnosed with appendicitis.<sup>11</sup> In crowded EDs, time is critical and rapid disposition is crucial. Moreover, delayed diagnosis of appendicitis leading to perforation is the leading cause of morbidity and mortality.<sup>12,13</sup>

The diagnosis of appendicitis is made by graded compression technique that was first described by Puylaert in 1986. A linear high-frequency transducer is placed on the right lower quadrant and pressure is applied gradually while imaging, displacing the overlying gas-filled loops of bowel.<sup>14</sup> Bedside ET ultrasound is becoming widely available. Ultrasound training in emergency physicians have demonstrated the ability to accurately perform focused ultrasound examinations.<sup>15</sup>

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Diagnostic accuracy is perhaps the single most important aspect to monitor in radiology because of its strong connections with health outcomes. At the threshold of uncertainty, radiologists can err on the side of making false-positive or false-negative decisions depending on their concern for the consequences of their decisions.<sup>16</sup>

Radiologists have reported sensitivities of 75 to 90%, specificities of 86 to 100%, and positive predictive values of 91 to 94%.<sup>17-19</sup>

Fox et al assessed the accuracy of emergency physicians using bedside ultrasound to detect appendicitis (BA). From the results, they concluded that insufficient evidence exists which could support the use of bedside ultrasound by emergency physicians to rule out appendicitis.<sup>20</sup>

Ang et al determined the accuracy of sonography in the diagnosis of clinically equivocal appendicitis. From the results, they concluded that ultrasound is a useful for the evaluation of acute abdominal pain in children.<sup>21</sup>

## CONCLUSION

The present study concluded that a total of 32 patients showed positive results for bedside ultrasound for appendicitis (BA). Out these 32 patients, 19 were affected by appendicitis while in 13 patients, appendicitis was absent. A total of 155 patients were reported to be BA negative. Out of them in 52 and 103 patients, appendicitis was present and absent, respectively. Proper training is required for performing ultrasound in suspected pathologies of abdominal region for avoiding false positive and negative cases.

## REFERENCES

1. Brewer BJ, Golden GT, Hitch DC, Rudolf LE, Wangenstein SL. Abdominal pain. An analysis of 1,000 consecutive cases in a University Hospital emergency room. *Am J Surg*. 1976;131:219–23.
2. Caterino S, Cavallini M, Meli C, Murante G, Schiffini L, Lotitio S, et al. Acute abdominal pain in emergency surgery. Clinical epidemiologic study of 450 patients. *Ann Ital Chir*. 1997;68(6):807–17.
3. Simmen HP, Decurtins M, Rotzer A, Duff C, Brutsch HP, Largiader F. Emergency room patients with abdominal pain unrelated to trauma: prospective analysis in a surgical university hospital. *Hepatogastroenterology*. 1991;38(4):279–82.
4. Brewer BJ, Golden GT, Hitch DC, Rudolf LE, Wangenstein SL. Abdominal pain. An analysis of 1,000 consecutive cases in a University Hospital emergency room. *Am J Surg* 1976;131:219–23.
5. Caterino S, Cavallini M, Meli C, Murante G, Schiffini L, Lotitio S, et al. Acute abdominal pain in emergency surgery. Clinical epidemiologic study of 450 patients. *Ann Ital Chir* 1997;68(6):807-17.
6. Roosevelt GE, Reynolds SL. Does the use of ultrasonography improve the outcome of children with appendicitis? *Acad Emerg Med* 1998;5(11):1071–5.
7. Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. *N Engl J Med*. 2003 Jan 16;348(3):236-42.
8. Doria A, Moineddin R, Kellenberger CJ, et al. US or CT for diagnosis of appendicitis in children and adults: a meta-analysis. *Radiology* 2006;241:83–94.
9. Yu SH, Kim CB, Park JW, Kim MS, Radosevich DM. Ultrasonography in the diagnosis of appendicitis: evaluation by meta-analysis. *Korean J Radiol* 2005;6:267–77.
10. McCraig LF, Burt CW. Advance data from vital and health statistics No 320. Hyattsville, Md.: National Center for Health Statistics; 2001. National Hospital Ambulatory Medical Care Survey: 1999.

11. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol.* 1990;132(5):910–25.
12. Colson M, Skinner KA, Dunnington G. High negative appendectomy rates are no longer acceptable. *Am J Surg.* 1997;174(6):723–7.
13. Von Tittle SN, McCabe CJ, Ottinger LW. Delayed appendectomy for appendicitis: causes and consequences. *Am J Emerg Med.* 1996;14(7):620–2.
14. Doria AS, Moineddin R, Kellenberger CJ, et al. US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis. *Radiology.* 2006;241:83–94.
15. Min YG, Lee CC, Bae YS, et al. Accuracy of sonography performed by emergency medicine residents for the diagnosis of acute appendicitis. *Ann Emerg Med.* 2004;44:S60.
16. Potchen EJ, Cooper TG, Sierra AE, et al: Measuring performance in chest radiography. *Radiology* 2000; 217:456-9.
17. Cook T, Roepke T. Prevalence and structure of ultrasound curricula in emergency medicine residencies. *J Emerg Med.* 1998;16(4):655–7.
18. Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. *N Engl J Med.* 2003 Jan 16;348(3):236–42.
19. Poortman P, Lohle PN, Schoemaker CM. Comparison of CT and sonography in the diagnosis of acute appendicitis: a blinded prospective study. *Am J Roentgenol.* 2003;181(5):1355–9.
20. Fox JC, Solley M, Anderson CL, Zlidenny A, Lahham S, Maasumi K. Prospective evaluation of emergency physician performed bedside ultrasound to detect acute appendicitis. *Eur J Emerg Med.* 2008 Apr;15(2):80-5.
21. Ang A, Chong NK, Daneman A. Pediatric appendicitis in "real-time": the value of sonography in diagnosis and treatment. *Pediatr Emerg Care.* 2001 Oct;17(5):334-40.