

Ultrasound and White Blood Cell Counts in Suspected Acute Appendicitis

WM West¹, DC Brady-West², AH McDonald¹, B Hanchard², D Fearon-Boothe¹

ABSTRACT

The use of radiological studies as diagnostic tools in patients with suspected acute appendicitis has increased recently. In this setting, abdominal ultrasonography is viewed as a possible means of avoiding unnecessary surgery. This retrospective study of patients who underwent laparotomy for suspected acute appendicitis was undertaken to determine the sensitivity and specificity of ultrasound in diagnosing acute appendicitis and the frequency of leucocytosis in patients in whom the diagnosis was confirmed by histology. The ultrasound and surgery registers were reviewed to identify 254 referrals for abdominal ultrasound between January 2001 and December 2002 because of a clinical suspicion of acute appendicitis. Of these cases, 223 did not proceed to surgery. The study sample comprised 31 patients who had appendectomies after abdominal ultrasonography. The ultrasound reports, pathological diagnoses and white blood cell counts of these patients were obtained and formed the basis for the analysis. A histological diagnosis was available for 30 cases, in 17 of whom appendicitis was confirmed. In these patients, positive ultrasound and leucocytosis were present in five (29%) and nine (53%) respectively. Ultrasound showed 92% specificity and 29% sensitivity for the pre-operative diagnosis of appendicitis. The positive predictive value of ultrasonography (83%) was higher than that of leucocytosis (69%). The sensitivity and specificity of ultrasound and leucocytosis in this study indicate limited utility as preoperative diagnostic tools.

Ultrasonido y Conteo de Glóbulos Blancos en Casos de Sospecha de Apendicitis Aguda

WM West¹, DC Brady-West², AH McDonald¹, B Hanchard², D Fearon-Boothe¹

RESUMEN

El uso de estudios radiológicos como herramientas de diagnóstico en los pacientes con sospecha de apendicitis aguda ha aumentado recientemente. En este escenario, la ultrasonografía abdominal se ve como un posible medio de evitar una cirugía innecesaria. Este estudio retrospectivo de pacientes sometidos a laparotomía por sospecha de apendicitis aguda, fue realizado a fin de determinar la sensibilidad y especificidad del ultrasonido a la hora de diagnosticar la apendicitis aguda así como la frecuencia de leucocitos, en pacientes en quienes el diagnóstico fue confirmado mediante histología. Se revisaron las historias de ultrasonido y cirugía con el propósito de identificar 254 remisiones para la realización de ultrasonido abdominal entre enero de 2001 y diciembre de 2002, debido a una sospecha clínica de apendicitis aguda. De estos casos, 223 no pasaron a cirugía. La muestra del estudio abarcó 31 pacientes a los que se les realizaron apendicectomías tras del ultrasonido abdominal. Se obtuvieron los reportes de los ultrasonidos, los diagnósticos patológicos y los conteos de glóbulos blancos de estos pacientes. Estos reportes constituyeron la base del análisis. Se tuvo a disposición un diagnóstico histológico en 30 casos, en 17 de los cuales se confirmó apendicitis. En estos pacientes, el ultrasonido resultó positivo en cinco casos (29%) y la leucocitosis estuvo presente en nueve (53%). El ultrasonido arrojó un 92% de especificidad y 29% de sensibilidad para el diagnóstico preoperativo de la apendicitis. El valor predictivo positivo de la ultrasonografía (83%) fue mayor que el de la leucocitosis (69%). En este estudio, la sensibilidad y especificidad del ultrasonido y la leucocitosis, indican una

From: Departments of Surgery, Radiology, Anaesthesia and Intensive Care¹, and Pathology², The University of the West Indies, Kingston 7, Jamaica, West Indies.

Correspondence: Dr WM West, Department of Surgery, Radiology, Anaesthesia and Intensive Care, The University of the West Indies, Kingston 7, Jamaica, West Indies. Fax: (876) 977-5277, e-mail: wayne_west@hotmail.

limitada utilidad tanto del ultrasonido como del conteo de glóbulos blancos como instrumentos preoperatorios de diagnóstico.

West Indian Med J 2006; 55 (2): 101

INTRODUCTION

The role of preoperative tests in cases of suspected acute appendicitis is a decrease in the number of unnecessary appendectomies. In this regard, any such test should have high specificity and sensitivity.

There are conflicting reports on the utility of ultrasound for diagnosing acute appendicitis. Gallego *et al* created a scoring system to assess the accuracy of ultrasound for the pre-operative diagnosis of acute appendicitis. Twelve variables were scored in 192 patients, and a cut-off point was assigned to select patients for immediate surgery or observation. Ultrasound increased diagnostic accuracy in this study (1).

Wilson *et al* in a prospective study of 99 patients, assessed the impact of computerized tomography (CT) and ultrasound on the clinical evaluation of suspected appendicitis. CT changed the proposed management of 22 patients, but ultrasound had no impact (2). Further, in a retrospective study of 766 patients, Lee *et al* reported that neither CT nor ultrasound was useful in the evaluation of patients diagnosed with acute appendicitis. In that study, migratory pain and an initial leucocytosis had a higher predictive value than either CT or ultrasound (3). Subsequently, Lee recommended adjunct techniques to improve accuracy when compression ultrasound is inadequate. These techniques aim to increase the frequency with which the normal appendix is visualized (4).

In 1995, Orr *et al* reported on a meta-analysis of studies of adults and children with appendicitis published between 1986 and 1994. Ultrasound was found to be 85% sensitive and 92% specific for the diagnosis of appendicitis (5). In a large multicentre study, German investigators found ultrasound not useful (6). Further, Wilson raised questions about the likelihood of achieving the sensitivities and specificities reported in the literature, since these excellent results were obtained by radiologists who had become very skilled in their field and therefore may not be reproducible in the setting of a community hospital (7).

The Radiology Department of the University Hospital of the West Indies, Jamaica, provides a 24-hour emergency service which includes ultrasound for suspected acute appendicitis. Patients are referred by both surgeons and non-surgeons, and the number of requests for imaging in patients with this clinical diagnosis has recently shown a considerable increase. In this study, we determined the sensitivity and specificity of ultrasound in the preoperative diagnosis of acute appendicitis, and compare the ultrasound findings and white blood cell counts in patients who have this diagnosis confirmed by histological examination of the resected appendix.

SUBJECTS AND METHOD

Data were obtained from the ultrasound, surgery, haematology and anatomical pathology registers of the radiology, surgery and pathology departments of the University Hospital of the West Indies, Jamaica. The list of patients referred for ultrasound evaluation after a clinical diagnosis of appendicitis during the period January 1, 2001, to December 31, 2002, was examined in order to identify those patients who subsequently went on to have appendectomy. The histological diagnoses of patients who underwent appendectomy were then obtained. The white cell counts of these patients within 24 hours preceding surgery were obtained. Leucocytosis was defined as a white cell count greater than $11 \times 10^9/L$.

Ultrasound examinations were performed by a radiology resident in at least the second year of the four year programme in radiology, using graded compression with 5-7 MHz transducers on 500 Logic GE Spectra (GE, Milwaukee, Wisconsin). The assistance of a consultant radiologist was requested in performing the examination if this was deemed necessary. A consultant radiologist issued reports on all examinations, having either supervised the study or reported on the films. The diagnostic criteria for appendicitis on ultrasound were those suggested by Birnbaum and Wilson (8): identification in the right iliac fossa of an echogenic mass and/or a non-compressible aperistaltic, tubular, laminated structure measuring at least 6mm in antero-posterior diameter.

Increased flow in the wall on colour doppler was regarded as confirmatory but not essential for diagnosis.

RESULTS

Thirty-one patients who had ultrasound evaluation after a clinical diagnosis of appendicitis underwent appendectomy. Pathology reports were available for 30 patients, 5 males and 25 females, of which 17 showed a histological diagnosis of acute appendicitis. Patients ranged in age from 5 to 51 years with a mean of 26.5 years. Six patients were less than 18 years old. Tables 1 and 2 summarize the results of ultrasound and white blood cell counts in these cases. Six patients were diagnosed with appendicitis on preoperative ultrasound; five true positives and one false positive. Ultrasound failed to

Table 1: Comparison of ultrasound and histological diagnosis

Ultrasound	Appendicitis	No appendicitis	Total
Positive	5	1	6
Negative	12	12	24
Total	17	13	30

Table 2: White blood cell counts and histological diagnosis

WBC	Appendicitis	No appendicitis	Total
Elevated	9	4	13
Normal	6	9	15
Total	15	13	28*

* White blood cell counts were not available for two patients.

detect 12 patients who had appendicitis, thus showing a high specificity (92%) but only 29% sensitivity for the preoperative diagnosis of this condition.

The WBC was elevated in nine patients with appendicitis, normal in six and not available in two cases. Leucocytosis was more frequently found in patients with confirmed acute appendicitis than positive graded compression ultrasound examination; however ultrasound had a higher positive predictive value (83%) than white blood cell count (69%).

DISCUSSION

These results compare favourably with other studies with respect to specificity but sensitivity is considerably lower than that reported in some series (5). Nevertheless, this study demonstrated higher sensitivity than some centres in a large review done in Austria and Germany where sensitivity was as low as 13%. These researchers did not find ultrasound useful in the preoperative confirmation of acute appendicitis (6). In their review of the publications between 1986 and 1994, Orr *et al* found that specificity varied between 86% and 100%, while sensitivity varied between 75% and 90%.

The subsequent use of CT scanning in suspected cases of acute appendicitis revealed that ultrasound was not as sensitive as claimed in initial reports. This was especially so in individuals above the age of ten years. In a paediatric population Sivit *et al* found ultrasound sensitivity to be 78% compared to 95% for CT (9). In contrast, in a review of adult patients, eighteen years and over, Wise *et al* found the sensitivity of ultrasound to be between 33% and 35% (10). Shovon also cited this shortcoming of ultrasound in a commentary on imaging in suspected cases of acute appendicitis (11).

The failure to consistently identify a normal appendix on ultrasound is a major factor in the low sensitivity of this modality in our study. The small sample size is a limitation of this study in that more than 80% of patients referred with an initial clinical suspicion of acute appendicitis did not have laparotomy. Ultrasonography was negative in all of these

patients; an analysis of the criteria employed to select patients for surgery is outside the scope of this study, but may be a matter for further investigation. The cases which comprise the study group were of necessity those in which the final histological diagnosis was certain.

The authors' experience reflects, at least with respect to sensitivity, the concern raised by Wilson (2) that the results obtained by the experts performing graded compression may not be reproduced in community hospitals where most cases of appendicitis are seen. The wide variation in reported sensitivity of ultrasound for diagnosing acute appendicitis in various studies, the superiority of computed tomography, and the technical inability to consistently identify a normal appendix on ultrasound imply that a negative ultrasound examination should not preclude the patient from having an appendectomy if there is strong clinical suspicion of the condition, particularly in the presence of leucocytosis. In this study, both ultrasonography and leucocyte counts proved to be of limited utility in the preoperative diagnosis of appendicitis.

REFERENCES

- Galindo Gallego M, Fadrique B, Neito MA, Calleja S, Fernandez-Acenero G, Ais G et al. Evaluation of ultrasonography and clinical diagnostic scoring in suspected appendicitis. *Br J Surg* 1998; **85**: 37–40.
- Wilson EB, Cole JC, Nipper ML, Cooney DR, Smith RW. Computed tomography and ultrasonography in the diagnosis of appendicitis; when are they indicated? *Arch Surg* 2001; **136**: 670–5.
- Lee HL, Walsh AJ, Ho HS. Computed tomography and ultrasonography do not improve and may delay the diagnosis and treatment of acute appendicitis. *Arch Surg* 2001; **136**: 556–62.
- Lee HL. Sonography of acute appendicitis. *Seminars in Ultrasound, CT, and MRI* 2004; **24**, No 2 (April): 83–90.
- Orr RK, Porter D, Hartman D. Ultrasonography to evaluate adults for appendicitis: decision making based on meta-analysis and probabilistic reasoning. *Acad Emerg Med* 1995; **2**: 644–650.
- Franke C, Bohner H, Yang Q, Ohmann C, Roher H. Ultrasonography for diagnosis of acute appendicitis. Results of a prospective multicentre trial. *World J Surg* 1999; **23**: 141–6.
- Wilson E. Surgical evaluation of appendicitis in the new era of radiographic imaging. *Seminars in Ultrasound, CT, and MRI* 2003; **24** No 2 (April) 65–68.
- Birnbaum BA, Wilson SR. Appendicitis at the millennium. *Radiology* 2000; **215**: 337–48.
- Sivit CJ, Applegate KE, Stallion A, Dudgeon DL, Salvator A, Schluchter M et al. Imaging evaluation of suspected appendicitis in a paediatric population: effectiveness of sonography. *Am J Roentgenol* 2000; **175**: 977–80.
- Wise SW, Labuski MR, Kasales CJ, Blebea JS, Meilstrup JW, Holley GP et al. Comparative Assessment of CT and Sonographic Techniques for Appendiceal Imaging. *AJR* 2001; **176**: 933–941
- Shovon PI. Imaging of appendicitis: a cautionary note. *Br J Radiol* 2002; **75**: 717–20.