THE EGYPTIAN JOURNAL OF MEDICAL SCIENCES VOL. 26-No. 2– DECEMBER 2005 (ISSN: 1110-0540)

1. Egypt. J. Med. Sci. 26 (2) December 2005: 273-278

THE VALUE OF ULTRASOUND IN THE DIAGNOSIS OF ACUTE APPENDICITIS

By

Abdulrahman Meccawi and

Mohammed Al-Harbi

Department of Surgery, King Abdulaziz University Hospital,

Jeddah, Saudi Arabia

e-mail: malharbi@dr.com

ABSTRACT

OBJECTIVE: To evaluate the accuracy of high-resolution real time ultrasound in diagnosing acute appendicitis.

METHOD: thirty-four consecutive patients admitted with clinical diagnosis of acute appendicitis underwent abdominal ultrasound. The diagnostic accuracy of the ultrasound was studied and compared with W.B.C and ESR.

RESULTS: Ultrasound was found to be easily obtainable and reliable with better specificity and sensitivity than W.B.C and ESR.

CONCLUSION: Ultrasonography is an important diagnostic tool that can help in the diagnostic dilemma of acute appendicitis.

INTRODUCTION

Although appendectomy is the most commonly performed emergency surgical operation (Rossi et al., 1996), the diagnosis of acute appendicitis remains one of the most challenging diagnosis in surgery. The rate of unnecessary operation for suspected acute appendicitis is as high as 25% and may reach more than 40% in females at childbearing age (Al-Jitawi, 1990; Skanne et al., 1990; Brown, 1991; Rossi et al., 1996; Garca and Gil, 2001). It is difficult to reduce the negative appendectomy rate without increasing the risk of perforation caused by delayed diagnosis. Most cases of acute appendicitis (80%) can be accurately diagnosed clinically (Makanjuola et al., 1993; Allemann et al., 1999) but up to 30% of patients may present with atypical signs and symptoms. A variety of diagnostic approaches have been described, including conventional radiographic examinations (Brown, 1991; Makanjuola et al., 1993) and computed tomography (Abu- Yousef et al., 1987; Brown, 1991; Makanjuola et al., 1993; Allemann et al., 1999; Lee et al., 2002) but none gained general acceptance.

The aim of this study is to evaluate the accuracy of high-resolution real time ultrasound in diagnosing acute appendicitis.

METHODS

Thirty-four consecutive patients were admitted through the emergency room department because of onset of

lower right abdominal pain. The data collected included age, sex, clinical picture, duration of symptoms, vital signs and clinical examination, WBC, ESR, C-reactive protein, blood in the urine and pathology report.

Ultrasound was consecutively performed in all of them by the same physician, using 3.5 MHz probe, 5 MHz convex probe and 7.5 linear array transducer. The technique for examining the appendix was first described by Puylaret (1986). The technique involves the use of a high-resolution linear array transducer (Dr. Puylaret had used a "T"-shaped linear transducer). The exam is started in the lateral right mid-abdomen just above the level of the umbilicus and continued caudally to the right lower quadrant with gradually increasing compression. Compression should be continued until all bowel gas and/or fluid is displaced. It is important to evaluate the compressibility of all imaged structures. It is also important to increase or decrease the compression slowly, so the patient will experience the least amount of discomfort possible. The compression should be undertaken with two hands, similar to the abdominal exam. If it is difficult to locate the appendix, we usually ask the patient to locate the area of greatest tenderness and evaluate the area closely.

We use the following sonographical criteria to diagnose appendicitis:

1. Maximal outer diameter greater than 6 mm.
2. Muscular wall thickness exceeding 3 mm.
3. Presence of appendicolith.
4. Appendix not compressible.

In five equivocal cases we performed follow-up scans.

At ultrasound we usually comment on the kidneys, gynecological organs, presence of free fluids, masses or the presence of tenderness.

RESULTS

This study included 34 patients (21 males, 13 females, 1.6:1) who underwent emergency appendectomy. The age varied between 12 to 67 with mean of 28 years. The mean hospital stay was 4 days. All of the 34 patients were clinically confirmed appendicitis and all of them underwent ultrasound examination before appendectomy, without clinical data to the radiologist apart from right lower quadrant abdominal pain.

Thirty patients proved histologically to have acute appendicitis (88%) of which 2 were perforated appendix (5%), 3 were gangrenous appendix (8%) and 4 appendicular abscesses (12%) as shown in Table (1). Four patients (12%) had normal appendix and all of them were females and had normal ultrasound findings. Only four patients out of the 34 patients had temperature above 38. Table (1) also shows comparison between different modalities of investigation, W.B.C.s, ESR, ultrasound and the final histological diagnosis.

The negative appendectomy rate in this series of patients was 12 % while 25 % of patients had advanced appendicitis at the time of surgery. C-reactive protein was negative in all patients including patients with advanced appendicitis.

This study is an initial attempt to provide preliminary data on the role of ultrasound in appendicitis.

Table (1): Data after appendectomy

Final Diagnosis	Number	W.B.C > 10,000	E.S.R >10	US
Normal	4	2	3	4
Acute appendicitis	21	9	18	21
Perforated Appendix	2	2	2	2
Appendicular abscess	4	3	3	4
Gangrenous appendix	3	2	1	3
Total	34	18	27	34

DISCUSSION

The diagnostic accuracy of a suspected acute appendicitis shows wide variations due to the absence of specific diagnostic methods and laboratory tests. It is reported to be around 86% (Rossi et al., 1996; Skanne et al., 1990; Makanjuola et al., 1993) and may reach as low as 61% (Al-Jitawi, 1990) in some studies.

Diagnostic accuracy of acute appendicitis in our study was 88 %. The diagnosis of acute appendicitis has always been reached on the basis of clinical evaluation supported in dubious cases by easily available laboratory tests such as white cell count or ESR. Twenty-seven out of thirty four patients (79%) in the present study, ESR was > 10, while white cell count was >10,000 in 18 patients (53%). C-reactive protein was negative in all patients.

The higher diagnostic accuracy in males than in females is considered to be due to clinical similarities with gynecological conditions that can mimic acute appendicitis. Ultrasound scan can be useful in detecting other abdominal or pelvic diseases simulating appendicitis. The sensitivity of ultrasound in diagnosing acute appendicitis (100%) is much better than ESR.

The appendix is normally only partially compressible at ultrasound examination, distinguishing it from the remainder of the normal bowel, which should be completely compressible. No peristalsis is seen when examining the appendix. Non-visualization of the appendix is considered normal; however, sometimes a normal appendix can be identified. The mucosa, if seen, will appear as a thin hyperechoic line surrounding the lumen. The wall of the appendix is hypoechoic and is usually <2 mm thickness with an overall cross-sectional diameter of less than or equal to 6 mm. A recent study has shown that 93% of the appendices measuring >6 mm at their greatest point are clinically inflamed appendices (Jeffrey et al., 1988; Vignault et al., 1990). Enlargement at the appendix is a sign of suppurative or gangrenous appendicitis (Borushuk et al., 1985; Jeffrey et al., 1988; Vignault et al., 1990; Worrell et al., 1990).

The inflamed appendix appears as a sausage-shaped, blind-ending structure on longitudinal, or as a target lesion, on transverse sections. The lumen of the appendix may be hyperechoic or, if fluid filled, anechoic. An appendicoliths, gas, or inspissated feces can be seen as an intraluminal hyperechoic structure with

or without an acoustic shadow. When an appendicolith is detected, the thickness and compressibility are not important in making the diagnosis of appendicitis.

Perforation of an inflamed appendix remains a common complication (5%) and in our study ultrasound showed free intra-peritoneal spillage.

Appendiceal abscess (12%) appears in the ultrasound as a complex mass in the right iliac fossa surrounding a swollen appendix. The mass contains highly reflective echoes with or without acoustic shadowing which may represent a fecolith or gas bubbles. Free fluid around the cecum and loss of the echogenic mucosal layer in the fluid-filled appendix were also seen.

Other processes may give similar clinical and ultrasound appearances. These include inflammatory lesions of the cecum or terminal ileum and neoplasms of the cecum or appendix (Geansler et al., 1989; Worrell et al., 1990; Allemann et al., 1999; Garca, 2001). In women, pelvic inflammatory disease may give similar clinical but different ultrasound appearances (Geansler et al., 1989; Worrell et al., 1990).

Our sensitivity (100%) in detecting an inflamed appendix in acute non-perforated appendicitis is comparable to other studies (Puylaret et al., 1987; Allemann et al., 1999; Chen et al., 2000). The proportion of appendices actually visualized with sonography in perforated appendicitis seems much less in some series (Borushuk et al., 1985; Puylaret 1986; Puylater et al., 1987; Worrell, et al., 1990). In early appendicitis, the relative absence of increased bowel gas permits good sonography visibility of an inflamed appendix, whereas in perforated appendicitis, reflex rigidity may hinder adequate compression technique, and peritonitis may cause atonic dilatation of bowel loops, covering up the inflamed appendix itself.

Ultrasonography is recommended in patients with suspected acute appendicitis and equivocal clinical findings. Our study confirms the findings of previous studies that high-resolution real-time sonography is fairly accurate and specific. Ultrasonography is of greatest value either when it definitively confirms appendicitis in patients with equivocal or atypical clinical findings or when it excludes appendicitis by diagnosing an alternative condition mimicking appendicitis. There can be no substitute for a complete history and physical examination. Ultrasonic scan should, on no account, replace clinical sense.

REFERENCES

1. **Abu-Yousef, M.M.; Bleicher, J.J.; Maher, J.W.; et al. (1987):** High-resolution sonography of acute appendicitis. AJR ;149: 53-58.

2. Al-Jitawi, S.A. (1990): Retrospective study of acute appendicitis in Jordan. Annals of Saudi Medicine;10(4): 426-28.

3. Allemann, F.; Cassina, P.; Rothlin, M. (1999): Ultrasound scans done by surgeons for patients with acute abdominal pain: a prospective study. Eur J Surg;165 (10): 966-70.

4. Borushuk, K.F.; Jeffrey, R.B. Jr, Laing, F.C.; Townsned, P.R. (1985): Sonographic diagnosis of perforation in

patients with acute appendicitis. J ultrasound Med ;4: 489-492.

5. Brown, J.J. (1991): Acute appendicitis : the radiologist's role. Radiology ;180: 13-14.

6. Chen, S.C.; Wang, H.P. and HSU, H.Y. (2000): Accuracy of ED sonography in the diagnosis of acute appendicitis. Am J Emerg Med;18(4): 449-52.

7. Gaensler, E.H.L.; Jeffrey, R.B. Jr, Laing, F.C.; Townsend, R.R. (1989): Sonography in patients with suspected acute appendicitis: value in establishing alternative diagnosis. AJR ;152; 49-51.

8. Garca Aguayo, Gil, P. (2001): Sonography in acute appendicitis: diagnostic utility and influence upon management and outcome. European Radiology, 10(12): 1886-1893.

9. Jeffrey, R.B. Jr.; Laing, F.C.; Townsend, R.R. (1988): Acute appendicitis: sonographic criteria based on 250 cases. Radiology ;167: 327-329.

10. Lee, J.H.; Jeang, Y.K.; Hwang, J.C. et al. (2002): Graded compression sonography with adjuvant use of a posterior manual compression technique in the sonographic diagnosis of acute appendicitis AJR, Apr ,178(1): 20-8.

11. Makanjuola, D.; Al-Qasabi, Q. and Malabarey, T. (1993): A comparative ultrasound and plain abdominal x-ray: evaluation of non-classical clinical cases of appendicitis. Annals of Saudi Medicine ;13(1): 41-6.

12. Puylaret, J.B.C.M. (1986): Acute appendicitis: Ultrasound evaluation using graded compression. Radiology ;158: 355-360.

13. Puylaret, J.B.C.M.; Rutgers, P.H.; Lalisang, R.I.; et al. (1987): A prospective study of ultrasonography in the diagnosis of appendicitis. New Engl J Med; 317: 666-669.

14. Rossi, P.; Covarelli, P.; Mosci, F.; Bisacci, R.; Sensi, B. and Maggo, L. (1996): Ultrasonography in the management of acute appendicitis. Surg Endosc; 10: 619-21.

15. Skanne, P.; Amland, P.F.; Nordshus, T. and Solheim, K. (1990): Ultrasonography in patients with suspected acute appendicitis: a prospective study. The British Journal of Radiology, 63: 787-793.

16. Vignault, F.; Filiatrault, D.; Brandt, M.L.; Garel, L.; Gruignon, A.; Ouimet, A. (1990): Acute appendicitis in children: evaluation with ultrasound. Radiology ;176: 501-504.

17. Worrell, J.A.; Drolshagen, J.F.; Kelly, T.C.; Hunton, D.W.; Durmon, G.R.; Fleischer, A.C. (1990): Graded compression ultrasound in the diagnosis of appendicitis: a comparison of diagnostic criteria. J Ultrasound Med ; 9: 145-150.

تقييم استخدام الأشعة فوق الصوتية
فى تشخيص الإصابة بالتهاب الزائدة الدودية الحاد

عبد الرحمن مكاوى ، محمد الحربى

قسم الجراحة – كلية الطب– جامعة الملك عبد العزيز– جدة– السعودية

كان الهدف من البحث الحالى هو تقييم فائدة الأشعة فوق الصوتية فى تشخيص الاصابة بإلتهاب الزائدة الدودية الحاد، وبالتالى فقد تم تشخيص أربعة وثلاثون حالة سريرياً كإلتهاب الزائدة الدودية ثم أجرى فحصهم بالأشعة فوق الصوتية ومقارنة النتائج بفحص الدم لسرعة الترسيب وعد كرات الدم البيضاء وقد أثبتت هذه الدراسة فائدة استخدام الأشعة فوق الصوتية فى تشخيص التهاب الزائدة الدودية الحاد وتبين أنها ذات حساسية ونوعية تفوق فحص الدم.

٢. المجلة المصرية للعلوم الطبية ٢٦(٢) ديسمبر ٢٠٠٥: ٢٧٣–٢٧٨.