Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(5A):1467-1470 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i05.007

Original Research Article

Improving accuracy of ultrasonography in diagnosing acute appendicitis with an additional imaging technique to current imaging protocol

Ananda Padmanabhan Jayajothi, Gurubharath Ilangovan, Hima bindu Tirumala setty, Harshavardhan Balaganesan
Department of Radiology, Shri Sathya Sai Medical College and Research Institute, Ammapetai, Kancheepuram, Tamil Nadu, India

***Corresponding author**
Dr. Ananda padmanabhan Jayajothi
Email: dr.anand@.live.in

Abstract: The main aim was to study the improvement in accuracy of ultrasonography in the diagnosis of acute appendicitis with the addition simple maneuver to the existing technique of ultrasound evaluation as primary imaging modality. The objective was to study the improvement in the diagnostic accuracy of ultrasound in diagnosing acute appendicitis hence the benefit of the patient and decrease the negative ultrasound diagnosis of appendicitis.
Keywords: Appendicitis, ultrasound diagnosis

INTRODUCTION

Appendicitis is one of the most common acute abdomens referred to the emergency department and most commonly encountered surgical emergency referred for imaging [1]. Although elusive, imaging plays an important role in diagnosing appendicitis. Although imaging by ultrasound may not be completely sensitive but remains an investigation that is repeatable, less expensive, non-ionizing imaging modality and dynamic study in trained hands [2, 3, 4].

Appendicitis is a commonly encountered acute abdomen referred from clinical unit to the imaging department for further assessment. Although elusive, ultrasound is one of the best first lines of investigations as it is easily available, non-radiation and dynamic mode of investigation. The study was conducted to evaluate the improving accuracy of ultrasonography in diagnosing acute appendicitis with an additional imaging maneuver. Imaging criteria for appendicitis include a thickened wall (> 3 mm), blind loop structure, non-compressible lumen, outer appendicular diameter > 6mm, echogenic periappendiceal fat; appendicolith with graded compression technique is used as in the normal conventional technique along with an additional maneuver of emptying the bladder and revaluating the patients with high resolution probe in the right iliac fossa for diagnosing appendicitis. This showed a marked increase in the number of new cases diagnosed which were equivocal by the conventional technique. This technique resulted in significant increase in negative predictive value and sensitivity as compared to the conventional technique. There is increased accuracy of diagnosis of acute appendicitis by ultrasound by adding a simple maneuver of emptying the bladder. This also aided in great patient comfort. Hence the overall negative appendix and negative laparotomy can be reduced.

MATERIALS AND METHOD:

A prospective observational study to evaluate improvement in the accuracy of ultrasound in the diagnosis of an acute appendicitis. Institutional ethical committee and Institutional scientific committee had reviewed our study and approved it. The study protocol and the final study design was also evaluated and approved by the institutional scientific committee. Over a period of eight months we enrolled patients admitted to the hospital and outpatients referred with suspected appendicitis. Ultrasound machine (High resolution probe 7 to 12 MHz -ultrasound Mind ray DC7 and Philips Clear view) Radiologists trained in ultrasound with more than three years of experience.

Inclusion criteria:

All inpatients and out patients suspected for appendicitis are included.

Exclusion criteria:

Critically sick patient, pregnant patient, Perforated appendicitis, Recent laparotomy, Very obese patients Imaging criteria for appendicitis include a thickened wall (> 3 mm), blind loop structure, non-compressible lumen, outer appendicular diameter > 6mm, echogenic periappendiceal fat, appendicolith.(5)Graded compression technique has been traditionally used with high resolution probe in the right iliac fossa for diagnosing appendicitis [5].This involves positioning the patient supine, using linear probe gradually apply pressure as the patient breathes and displacing the excessive bowel gas that hinders the visualization. The patients are asked to void the bladder next and then the same maneuver is employed for rest of the examination. The patient is classified as normal or with appendicitis or with non-appendicular pathology. The examination is stopped in patients with non-appendicular pathology.

STUDY PROTOCOL:

Supine position and graded compression technique using a high frequency probe in the right iliac fossa. Emptying the bladder and reevaluating.

DATA ANALYSIS

Table-1: Study Report of appendicitis cases

Total number of patients with right iliac fossa tenderness and referred as suspicious of appendicitis	**148**
Total number of patients diagnosed as appendicitis in ultrasound	**111**
Appendicitis diagnosed before emptying the bladder	**87**
Appendicitis diagnosed after emptying the bladder	**24**
Non appendicular cause	**24**
Negative on ultrasound	**13**

A total of 148 patients with right iliac fossa tenderness referred to the imaging department as highly suspicious of appendicitis were included in the study. One hundred and eleven patients were diagnosed as appendicitis on ultrasound based on the existing imaging criteria for appendicitis. Among this 87 patients (78.3 %) were diagnosed with appendicitis with existing imaging technique i.e. gradual graded compression technique in the right iliac fossa using a high frequency linear probe, the rest of 24 patients (21.6 %) were diagnosed after emptying the bladder with similar graded compression technique. Among this 24 patients diagnosed with appendicitis with emptying the bladder10 (21.6 %) were equivocal and 14 (58.3 %) could not be evaluated completely pertaining to patients and technical limitations. Among 24 patients who were diagnosed with appendicitis after emptying the bladder it was found that four (16.6 %) of them were obese patients with abdominal fat thickness measuring more than 4.5 cm. Even though we wanted to exclude obese patients from the inclusion criteria emptying the bladder was found to be very helpful as appendix was visualized. It is observed that even in the initially diagnosed patient with appendicitis without emptying the bladder 22 (29.3 %) patients had partially distended bladder which was equivalent to the present technique of emptying the bladder. In 13 patients (8.7 %) the ultrasound could not demonstrate the inflamed appendix despite the strong clinical suspicion 6 were found to have a retrocaecal position and rest of them could be owing to the technical difficulties of ultrasound. The rest of 24 (16.2 %) patients showed non appendicular pathology which included renal and ovarian causes. The overall sensitivity of emptying the bladder and diagnosing appendicitis is 93.2% (87.2% -97.0% in 95% CI range) which was more than the sensitivity when the evaluation was done as routine evaluation with full bladder 91.5% (84.08% -96.29% in 95% CI range). The negative predictive value of diagnosis acute appendicitis with emptying the bladder was 88.18 % (80.6% -93.5% in the 95 % CI) and was found to be greater than when the evaluation was done without emptying the bladder 64.86 (47.46% -79.79% in the 95 % CI).

Fig-1:

This is a high-resolution ultrasound image using linear probe with gradual linear compression and empty bladder. The image shows distended inflamed appendix which in this case was tortuous such that in one plane both the transverse and longitudinal sections are visualized. The transverse diameter is 7.3 mm with edematous wall and altered periappendiceal fat.

RESULTS:

It has been observed that there is a significant increase (32.4 % patients) in the diagnosis of acute appendicitis using ultrasound by emptying the bladder and reevaluating the patients.

DISCUSSION:

Appendix is a vestigial organ. It is a narrow hallow blind ended tubular structure attached from the base of the caecum [6].Appendicitis is inflammation of appendix probably secondary to impacted fecal material or faecolith. Inflamed appendix is blind enlarging tube which can have all likelihood to rupture, turn gangrenous secondary to obstruction. Before the advent of imaging science the diagnosis of appendicitis was based on clinical presentation and later the laboratory changes. With the advent of advancement in imaging plays an important role in diagnosis of appendicitis without delay or clinically missed patients [7,8].Ultrasonography is universally available, cheap, and easy to use and doesn't involve the use of radiation that has the potential for highly accurate imaging in patients with suspected acute appendicitis [9,10,11].

There is a dramatic increase in use of ultrasound after the introduction of graded-compression US by Puylaert in 1986[5,12]The major advantages of Ultra sonogram over other imaging modalities include its noninvasiveness, short acquisition time, lack of radiation exposure, and potential for the diagnosis of other cases of abdominal pain, particularly in the subset of women of childbearing age. A retrospective study, carried out by Krishnamurthy R *et al.;*on 1,228 children with suspected appendicitis during 2003-2008, evaluated the use of a staged protocol using first ultrasound, and subsequently CT, results concluded that the sensitivity and specificity were equivocal and there were a substantial decrease in the radiation dose[13].An evidence-based review of the role of graded compression US for the diagnosis of appendicitis was performed by Terasawa and coworkers: they found that 14 studies of graded compression US could meet their inclusion criteria: Ultrasonography showed an overall sensitivity of 0.86 and a specificity of 0.81, a positive predictive value of 84%, and a negative predictive value of 85%[14].As observed in various study and trials in the literature ultrasound has its own limitation and advantages as far as diagnosis of acute appendicitis. In our institution we have a protocol of subjecting patients initially with ultrasound imaging and in equivocal or complex cases ordering a CT abdomen low dose with contrast when needed. The overall sensitivity and specificity of ultrasound in diagnosing appendix was correlating with the literature. We observe that emptying the bladder would greatly contribute to the diagnosis acute appendicitis by ultrasound hence reducing the negative appendicitis and eventual complication and morbidity. We observed that this small and simple maneuver resulted in diagnosis 27 % more to the existing diagnosed cases. This also changed

overall sensitivity and specificity. Apart from the increased ability to diagnosis this maneuver also added greatly to patient comfort which aided for better and deeper compression hence better diagnosis. We also observed that even patients who initially were diagnosed with appendicitis on ultrasound without emptying the bladder were much more comfortable when evaluated with empty bladder.

CONCLUSION:

There is increased accuracy of diagnosis of acute appendicitis by ultrasound by adding a simple maneuver of emptying the bladder. This also aided in great patient comfort. Hence the overall negative appendix and negative laparotomy can be reduced. The study can be taken further by including a larger sample size which would be more confirmative.

REFERENCES:

1. Reginelli A, Pezzullo MG, Scaglione M, Scialpi M, Brunese L, Grassi R; Gastrointestinal disorders in elderly patients. Radiol Clin North Am 2008; 46(4):755-71.
2. Pittman-Waller VA, Myers JG, Stewart RM, Dent D.L; Appendicitis: why so complicated? Analysis of 5755 consecutive appendectomies. AmSurg 2006; 66(6):548-555.
3. Addis DG, Shaffer N, Fowler BS, Tauxe R.V.; The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol 1990; 132(5):910-925.
4. Vissers RJ, Lennarz WB; Pittfals in appendicitis. Emerg Med Clin N Am 2010;28:103-118
5. Puylaert JB; Acute appendicitis: US evaluation using graded compression. Radiology 1986;158:355-360
6. Richard Drake, A. Wayne Vogl, Adam W.M; MitchellGray's Anatomy for Students Elsevier Health Sciences, 30-Jan-2014 ISBN 0702051330, 9780702051333
7. Reginelli A, Mandato Y, Solazzo A, Berritto D, Iacobellis F, Grassi R; Errors in the radiological evaluation of the alimentary tract: part II. Semin Ultrasound CT MR 2012; 33(4):308-17.
8. Stabile Ianora AA, Lorusso F, Niccoli Asabella A, Di Maggio P, Fonio P, Losco M, *et al.;* Multi detector CT for the assessment of the groin region. Recent Prog Med 2012; 103(11):483-8.
9. Gracey D, McClure MJ; The impact of ultrasound in suspected acute appendicitis. Clin Radiol. 2007; 62(6):573-8.
10. Jang KM, Lee K, Kim MJ, Yoon HS, Jeon EY, Koh SH, *et al.;*What is the complementary role of ultrasound evaluation in the diagnosis of acute appendicitis after CT? Eur J Radiol. 2009.
11. Wan MJ, Krahn M, Ungar WJ, Caku E, Sung L, Medina LS, *et al.;*Acute Appendicitis in Young Children: Cost-effectiveness of US versus CT in Diagnosis--A Markov Decision Analytic Model. Radiology. 2008 Dec 19.
12. Van Randen A, Bipat S, Zwinderman AH, Ubbink DT, Stoker J, Boermeester MA; Acute appendicitis: meta-analysis of diagnostic performance of CT and graded compression US related to prevalence of disease. Radiology. 2008; 249(1):97-106.
13. Krishnamurthy R, Ramarajan N, Wang NE, Newman B, Rubesova E, Mueller CM, *et al.;*Effectiveness of a staged US and CT protocol for the diagnosis of pediatric appendicitis: reducing radiation exposure in the age of ALARA. Radiology. 2011; 259(1):231-9.
14. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ; Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Ann Intern Med 2004; 141:537-5466.