ORIGINAL ARTICLE

VISUALIZATION OF NORMAL APPENDIX ON MDCT; QUESTIONING THE SIZE CRITERIA FOR APPENDICITIS!

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ABSTRACT

Objective: To evaluate the frequency of visualization, position, caliber of appendix on MDCT in patients without any clinical suspicion of appendicitis or history of prior surgery. **Materials and Methods:** 100 CT Scans were prospectively reviewed and radiologists were aware of the history at the time of image interpretation. Both unenhanced and contrast studies were included in the study. Two Radiologists reviewed the scans together, assessing axial, coronal and sagital images. The frequency of the visualization of appendix was recorded with the assessment of position and caliber. **Results:** Normal appendix visualized in 98% of patients and the range of normal caliber was found to be 4 – 11 mm. **Conclusion:** MDCT is extremely useful for visualization of normal appendix. The normal appendix is very variable in its position and caliber. The understanding of variation in the thickness of the normal appendix and wide variation in its position and length will help in the evaluation of appendix and will improves accuracy in the diagnosis of appendix related pathologies especially appendicitis. In the absence of other signs, the diagnosis of acute appendicitis should be made with extreme caution without considering the thickness of the appendix solely.

KEY WORDS: Normal appendix, MDCT, size criteria

Introduction

Acute appendicitis is one of the most common causes of acute abdominal pain. Ultrasound (US) has traditionally been widely and accurately used for the diagnosis of acute appendicitis. Sonographic criteria for the diagnosis of acute appendicitis is visualization of aperistaltic, non-compressible intestinal segment arising from caecum that measures more than 6 mm in diameter. An appendicolith which leads to obstruction of the appendix can also be demonstrated with ultrasound. Doppler ultrasound might contribute for the diagnosis of the appendicitis by demonstration of increased blood flow in the wall of the appendix in non-perforated cases, and by showing loss of perfusion in perforated cases.[1,2,3,4] There are many studies in the literature for the CT diagnosis of appendicitis utilizing oral, rectal and intravenous contrast agents. CT criteria for the diagnosis of acute appendicitis primarily depend upon US criteria.[1,2,3] In the literature, there are only few studies which assess CT criteria of the normal appendix.

Because of the introduction of multi detector technology, giving higher spatial resolution the visualization of a normal appendix is expected to be better with MDCT. Most of the previous studies have been conducted on helical scanners and most of those have focused on the abnormal rather than normal appendix. In contrast to ultrasound, CT is less operator dependant, and with the introduction of multi detector technology the visualization of appendix improves as we can evaluate the structures in multiple planes. Although ultrasound is widely available but its operator dependency and many other factors related to the patient will cause additional problems in the localization of normal as well as abnormal appendix.

Therefore, it is necessary to know the identification rate of the normal appendix and to make efforts to search for the normal appendix on CT.

Normal appendix is more commonly visualized at CT than ultrasound practically excluding the diagnosis of acute appendicitis. The question however still remains that which appendix is to be called normal?

Different CT techniques have been used for appropriate

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detection of abnormal appendix including unenhanced and enhanced scans with IV, both oral and IV and sometimes, oral, IV and intrarectal.

Reported accuracies[1,3] of these techniques have varied but generally are comparable. This explains the gaining popularity of techniques without intravenously and/or rectally administered contrast material to make the procedure simpler as well as fast for the detection of such surgical emergency.

Limited studies are available in literature in which normal appendix were evaluated and much less even, on MDCT.

In many text books of radiology and published articles on the topic of appendicitis, the upper limit for normal appendiceal thickness has been taken as 6mm. The reported thickness of a normal appendix at CT is based mostly on ultrasound results,[6] using 6-mm short-axis thickness as the upper limit of normal.

The purpose of our study was to evaluate the frequency of visualization, normal caliber and position of the appendix in patients not having any clinical suspicion of appendicitis as a primary provisional diagnosis.

Materials and Methods

We conducted a prospective study on abdominal CT scans performed between October 2008 and February 2009. 100 CT examinations were selected for the study. In all the patients there was no clinical suspicion of acute appendicitis. All the patients with history of appendectomy were excluded from the cohort. Patients incidentally diagnosed as having inflamed or perforated appendix were also not included in the study. We also excluded those cases which had other pathologies centered in the right iliac fossa region since they can affect the caliber of appendix including inflammatory and neoplastic pathologies.

All the examinations were carried out on a 16 detector row MDCT (Toshiba Activion). Out of 100, 70 examinations were carried out with and 30 without IV contrast administration.

The volume data were transferred to VITREA 2 workstation. All interpretations were made on the actual data volume. Axial, coronal and sagittal images were also assessed. The visualization of appendix was recorded in all 3 planes. All the scans were reviewed by 2 radiologists having experience in working with Vitrea 2 and its applications, and the findings discussed and concluded with consensus.

The position of caecum was assessed with the localization of ileocaecal junction. The appendix was interpreted as i) visualized or ii) not visualized. The maximum thickness of the appendix was measured in the best visualized section. To make the standardization, the measurement was taken from the area of maximum caliber where there was no intraluminal air or contrast. Presence of air, contrast and/or appendicolith was recorded. Reviewers identified the position of the tip of appendix as Retrocaecal, lateral, medial, inferior, midline, pelvic and sub hepatic.

All the information noted down on a designated proforma.

To determine the mean and range of appendiceal thickness, we used measurements of the appendices that were seen by the reviewers. As the 2 Radiologist read the images at the same time only the frequency of the findings were calculated.

Results

A total of 100 patients included in the study. Out of these 64% were females and rest male. Age range was between 18 and 78 years. Contrast enhanced CT was done in 70 patients and 30 were done without contrast. The normal appendix was visualized in 98 patients and in only 2 cases we could not identify the appendix. 90 of the scans showed an appendix on axial images without the need to see the coronal sections and in 8 of the patients additional evaluation on coronal images was required to identify and localize the appendix. The most common position of the appendiceal tip was medial (54%) followed by retrocecal (26%), subhepatic (6%), pelvic (8%) and inferior (4%). 30% appendices were collapsed and did not contain any air, fecal matter, fluid or contrast. 62% had intraluminal air detectable on CT and 6% had either fluid or contrast in its lumen.

The minimum caliber of appendix that we encountered was 4 mm with a maximum of 11mm. The mean caliber was 7.1 mm. 44% of patients had a caliber of greater than 7mm.

Discussion

Appendicitis is a common cause of acute abdominal pain and generally has been a clinical diagnosis in which radiology has had a limited role. The overall negative appendectomy rate, or rate of normal appendix at pathologic examination, was 20% prior to the use

of cross-sectional imaging.[7] With the widespread use of US and CT, there has been improvement in the preoperative diagnosis of appendicitis, and the results described in one study indicate a significant reduction in the negative appendectomy rate to 4%.[5]

The appendix usually has a curved and tortuous course, and axial images alone have limitations for tracing this course, especially in the case of a retrocaecal appendix or an appendix extending into the pelvis. Therefore, the coronal reformation images greatly assist in the tracing and demonstration of these appendices. Moreover, the coronal images more easily demonstrate the entire anatomic configuration of the ileocaecal valve, the caecum and the base of appendix, which are also helpful for identification of the normal appendix .

CT has become part of the standard of care in managing patients with suspected acute appendicitis. CT evaluation of appendicitis without the use of intravenously administered contrast material is a growing trend. Some authors[1,2,3,4] have advocated the use of examinations with both orally and rectally administered contrast material, and others, the use of examinations without contrast material. However, in the absence of intravenously administered contrast material, the true wall thickness can be measured only if the luminal content of the appendix can be recognized. Since all normal appendices do not fill with rectally or orally introduced contrast material and the content is not always recognizable from the wall, it is important to determine the range of the thickness of the normal appendix at non enhanced CT.

Levine et al[6] reported that factors such as paucity of intra-abdominal fat and the presence of a small bowel dilatation could influence the false-negative diagnosis of appendicitis by CT. Similarly, the identification of the normal appendix by axial CT may be dependent on the amount of intra-abdominal fat and the presence of a small bowel dilatation. Intra-abdominal fat serves as a natural contrast agent, allowing soft-tissue attenuation that constitutes the normal appendix to be easily detected.

Jan et al however reported that the degree of intra-abdominal fat did not significantly influence the visualization of the normal appendix when using multiplanar reformation images. This factor obviously greatly enhances observer confidence in excluding appendicitis.

The main CT criteria of acute appendicitis published in the literature includes identification of a thickened appendix with a two-wall diameter greater than 6 – 7 mm, peri appendiceal inflammatory changes, and a calcified appendicolith.[8,9] The size criterion to diagnose appendicitis is especially important in the absence of peri appendiceal fat stranding. In a recent study by Jacobs et al, there was no periappendiceal stranding at nonenhanced CT in 22% cases of appendicitis. The value for normal and abnormal thickness of the appendix is derived from ultrasound studies.[7,8,9] However, on ultrasound the appendix can be compressed and, therefore, the true wall thickness excluding the content can be measured.

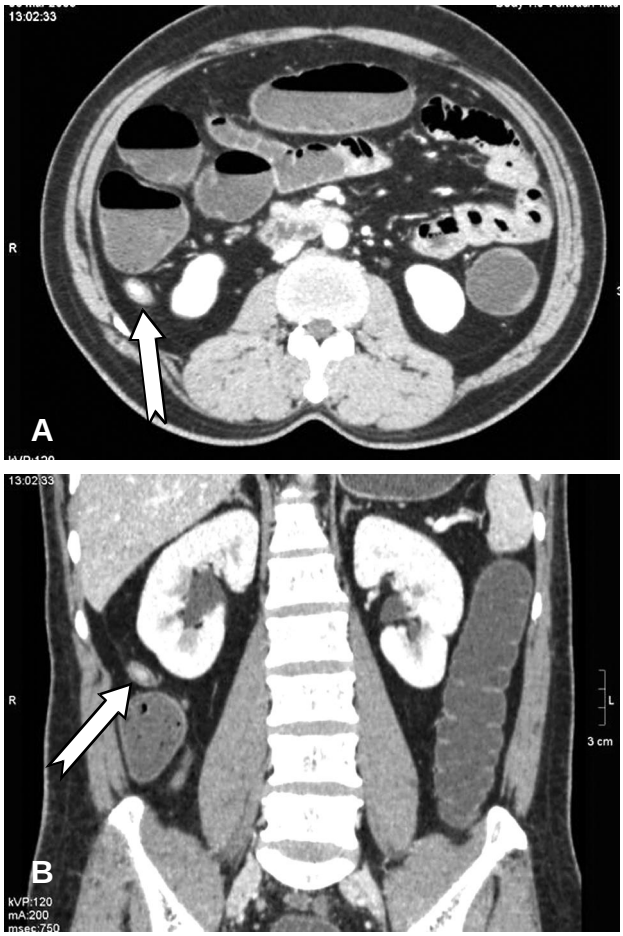

Figure 1: (A, B) Axial and coronal images of CECT showing 11mm thick appendix(arrow). This patient was diagnosed with Ca rectum.

In one of the recent study done on 64 slice MDCT , the author compared the visulaization of normal appendix on 4 slice, 16 slice and 64 slice MDCT. They mentioned that Jan et al using 16-slice MDCT with multiplanar reformation images reported that the visualization rate of the normal appendix had increased to 93%, identification rate of the normal appendix in healthy adults was 94% using 4-slice MDCT. The

results on 64 slice MDCT showed that the identification rate of appendix with the addition of coronal reformation images was 98.5%, which is the highest rate the reported so far when compared with previous studies. In our study the visualization of normal appendix on 16 slice MDCT is 98% which is comparable with the 64 slice MDCT.[5]

Figure 2: (A, B) Non contrast CT showing 4 mm thick normal appendix(arrow). This patient had a small left ureteric calculus.

The range of full thickness of the normal appendix in our series was 4 -- 11mm. The mean thickness of the normal appendix was 7mm. A significant number of patients had an appendix larger than 7 mm in caliber. Therefore, we suggest that the diagnosis of appendicitis is indeterminate at CT, solely based on the size criteria. Since the cohort in our study was not referred for exclusion of appendicitis, we cannot determine in what percentage of patients with documented acute appendicitis the appendiceal thickness overlaps with the normal values seen in the cohort in our study. We did not observe any significant difference in the detection of appendix on axial images alone and when combined with other planes. This finding differs from what the literature generally describes. An explanation however could be that we evaluated the actual volume data sets for all patients that used 1mm sections rather than reformatting thicker slices with inter slice gaps.

Conclusion

In conclusion, our study results showed that MDCT is excellent in the evaluation of the normal appendix. In the absence of other signs, the diagnosis of acute appendicitis should be made with extreme caution without considering the thickness of the appendix solely. The importance of correlation with clinical and laboratory information also needs to be emphasized. We suggest that the criteria of the thickness of appendix in the diagnosis of appendicitis should be revised.

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