Role of Multislice Computed Tomography in Diagnosis of Acute Appendicitis

Essay

Submitted for the Partial Fulfillment
of Master Degree in Radio diagnosis

By

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2015

Acknowledgement

First and fare most, I feel always indebted to Allah, the most kind and the most merciful.

I would like to express my deepest gratitude to

Prof. Dr. Saad Ali Abd Rabou *Professor of radio diagnosis ,faculty of medicine, Ain-Shams university, to whom I owe very much, for planning and supervising this work, for his constructive criticism, and for his close valuable guidance all through this work. I will never be able to express my feeling toward him with simple words, and I wish to be able one day to return to him a part of what he had affered to me.*

.Dr. Ahmed Mohamed Fathi *Assistant Professor of Radiodiagnosis, Faculty of Medicine – Ain-Shams University, for her faithful supervision, understanding, help and encouragement in initiating and completing this work.*

Lastly but not least, I would like to thank my wife and my family whose continuous encouragement and support have made this work easier to accomplish.

Introduction

Use of CT for suspected appendicitis has increased dramatically since the late 1990s, with 85–93% of patients undergoing preoperative CT in recent years. The improvement in outcome associated with this surge has been attributed to "increased use of high quality preoperative CT, with the results interpreted by experienced abdominal radiologists". After the implementation of helical CT technology, research studies aimed at protocol optimization have been essential to delineating best practice techniques. With MDCT technology, much attention has been focused on data set reconstruction and display, in particular, multiplanar reconstruction (MPR). Improvements in z-axis resolution have made multiplanar volume interrogation a valuable adjunct to data set evaluation ***(Johnson et al., 2012).***

The diagnosis of acute appendicitis is straightforward in most patients who present with typical clinical symptoms and signs. It is not uncommon, however, to face difficulties in making a diagnosis of appendicitis in patients who have an equivocal presentation. Conventional Radiographs present nonspecific findings, such as regional bowel dilatation, in most cases of acute appendicitis. The most specific finding on plain radiographs is the presence of a calcified appendicolith, which is noted in about 10% of adults with appendicitis ***(John et al., 2011).***

CT and sonography are powerful imaging tools that substantially improve the diagnosis of acute appendicitis. Both imaging studies are highly accurate, and their introduction has lowered the rate of false-negative appendectomy (removal of a normal appendix). Although sonography is preferred to CT as the initial imaging study for young, female, and slender patients, in addition ultrasonography is considered to be useful for direct visualization of the inflamed appendix, assessment for the degree of inflammatory changes,

identification of abscess formation or free peritoneal fluid, differentiation from other acute abdominal disorders, and application to pregnant patients. The use of multislice computed tomography (MSCT) as a diagnostic examination for acute appendicitis has increased during the past few years ***(Shelton&Mckinely, 2013).***

CT is believed to be more helpful than sonography for staging periappendiceal inflammation, making alternative diagnosis, and visualizing a normal appendix. Although it is debatable which of these two imaging techniques more accurate, a 2008 meta- analysis showed that CT has better diagnostic performance than sonography ***(Seo et al., 2010).***

Computed tomography (CT) is an accurate and effective modality for the diagnosis and staging of appendicitis. CT provides rapid and complete evaluation of patients with suspected appendicitis and clearly demonstrates the typical findings of appendicitis, including a distended appendix, periappendiceal fat stranding, an appendicolith, and focal thickening of the caecum ***(Kim et al., 2011)***

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Either CT or ultrasound can be used to guide abscess drainage. Preference to use CT because of the more precise definition of the access route to the collection. The CT guidance is mandatory for collections that are not seen clearly by ultrasound, and where the access route is not clearly defined by ultrasound; these include deep-seated collections such as retroperitoneal collections ***(Marincek &Dondelinger, 2012).***

Aim of work

The aim of the work is to describe the value and role of Multislice computed tomography in diagnosing acute appendicitis and its intervention role in treatment of appendiceal complications.

Anatomy and CT anatomy of the appendix

Gross anatomy:

The vermiform appendix is a blind ended tube connected to the caecum from which it develops embryologically .The term vermiform comes from latin and means "wormlike in appearance". The caecum is a pouch like structure of the colon. The appendix is near the junction of the small intestine and the large intestine [Fig.1] ***(Ryan & McNicholas, 2009).***

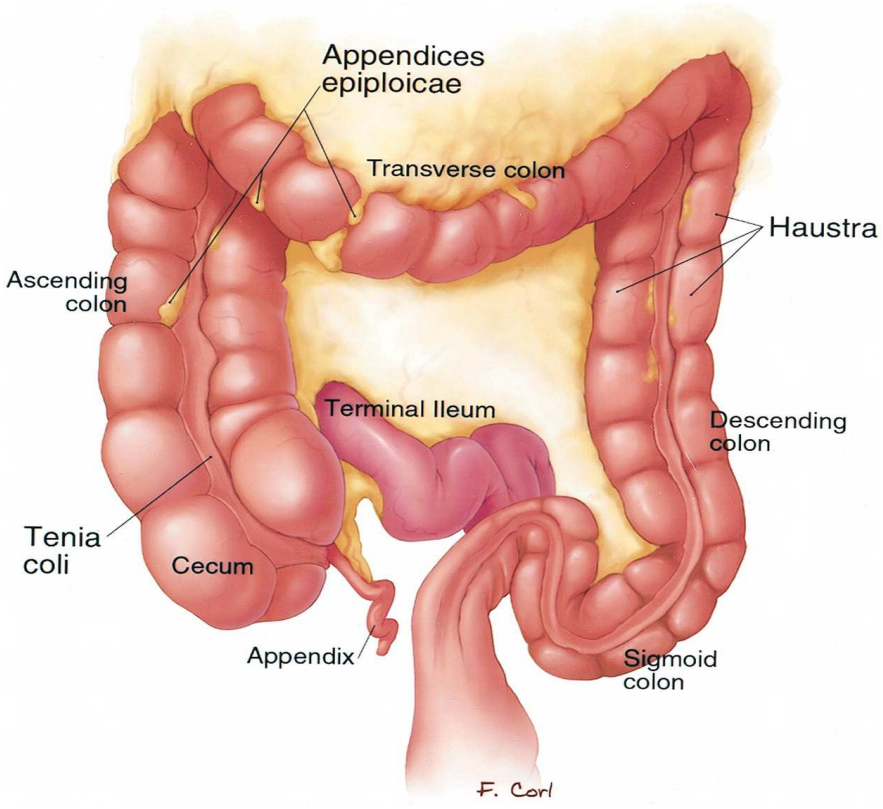


Fig. (1): *Normal location of the appendix relative to other organs of the digestive system, frontal views* ***(Horton &Fishman, 2008).***

The appendix measures 10 cm in average length, but can range from 2 to 20 cm. The diameter of the appendix is usually between 7 and 8 mm .The longest appendix ever removed measured 26 cm. It is longer in the child than in the adult and may atrophy and become smaller after mid adult life ***(Warwick & Williams, 2011).***

The appendix is located in the lower right quadrant of the abdomen or more specifically the right iliac fossa. Its position within the abdomen corresponds to a point on the surface known as McBurney's point. It is the name given to the point over the right side of the human abdomen that is one third of the distance from the ASIS (anterior superior iliac spine) to the umbilicus; this point roughly corresponds to the most common location of the base of the appendix where it is attached to the cecum. The anterior cutaneous branch of iliohypogasteric nerve is found near McBurney's point [Fig.2] ***(Warwick & Williams, 2011).***

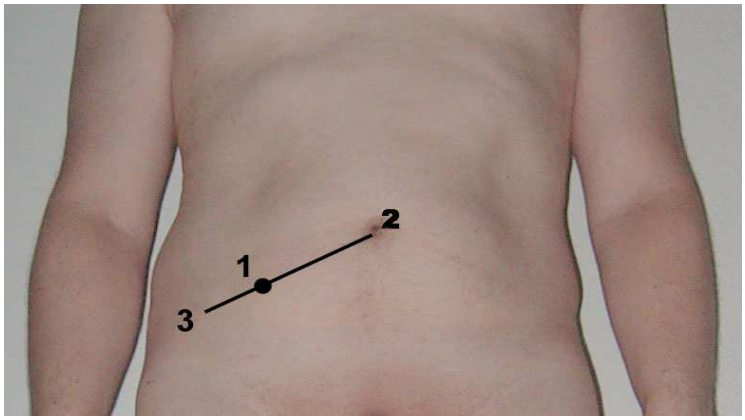


Fig. (2): *Location of McBurney's point (1), located two thirds the distance from the umbilicus (2) to the anterior superior iliac spine (3)* ***(Richerad & Chung, 2008).***

The base of the appendix is located in a fairly constant location, 2 cm below the ileocaecal valve at the medial side of the caecum where the taeniae coli fuse. The appendix is attached to the ileocaecal Part by a mesoappendix containing the appendicular artery, a branch from the ileocolic artery ***(Warwick & Williams, 2008).***

***** The location of the tip of the appendix is extremely variable in position and may occupy one of several conditions [Fig.3]:

A. It may lie behind the cecum and lower part of the ascending colon (retrocaecal and retrocolic) 65.5 %.

B. It may hang down over the brim of the pelvis in which case it lies in close relation to the right uterine tube and ovary in the female (pelvic or descending) 31%.

C. It may lie below the caecum (subcaecal) 2%.

D. It may lie in front of the terminal part of the ileum and may then be in contact with the anterior abdominal wall (pre ileal) 1%.

E. It may lie behind the terminal part of the ileum (post ileal) 0.5%.

F. With situs inversus the appendix may be located in the lower left side ***(Delic et al., 2010).***

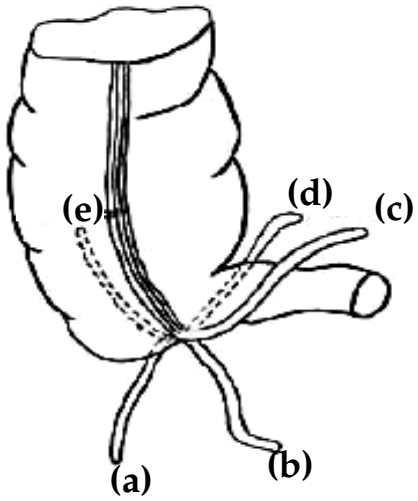


Fig. (3): *Positions of vermiform appendix. The appendix positions were classified into subcaecal (a), pelvic (b), preilial (c), postilial (d), and retrocaecal (e)* ***(Delic et al., 2010).***

The vermiform appendix is connected by a short mesenteriole (mesoappendix) to the lower part of the ileum which is triangular in shape [Fig. 4] ***(Warwick & Williams, 2011).***

Fig. (4): *The mesoappendix is derived from the posterior side of the terminal ileal mesentery. It attaches to the cecum and to the proximal appendix. It contains the appendiceal vessels* ***(Warwick & Williams, 2011).***

The lumen of the appendix is small and communicates with the caecum by an orifice which is placed below and a little behind the ileocaecal opening. The orifice is sometimes guarded by a semilunar valve formed by a fold of mucous membrane, this valve probably does not function in life although occasionally the appendix, even with patent lumen ,will not fill immediately at the time of barium enema and will be seen to contain barium 24 or more hours later . The lumen of the appendix may be partially or completely obliterated after mid adult life ***(Warwick & Williams, 2011).***

Microscopic anatomy:

As regard the structure of the appendix it is formed of four coats from outside to inside which are serous, muscular, submucosa and mucous membrane .

1- **Serous Coat:** It forms a complete investment for the tube except along the narrow line of attachment of its mesentery. Beneath the serous coat lies a layer of subserous areolar tissue.

2- **Muscular Coat:** It consists of an outer longitudinal and inner circular layer. The longitudinal muscular fibers form a uniform thick layer which invests the whole organ, except at one or two points where both the longitudinal and circular layer may be deficient, so that the peritoneal and submucous coats are contiguous over small areas at the base of the appendix. The longitudinal muscle becomes thickened at three points around the perimeter to form incipient taenia coli which become continuous with those of the colon. The circular muscular fibers form a thicker layer than the longitudinal fibers and are separated from them by a small amount of connective tissue.

3- **Submucous Coat:** It is well developed, and contains a large number of masses of lymphoid tissue which cause the mucous membrane to bulge into the lumen and so render it of small size and irregular in shape**.** This lymphoid tissue undergoes progressive atrophy during life to the point of complete disappearance in advanced age, in the elderly, sometimes undergoes fibrous obliteration.

4- **Mucous Membrane:** It is lined with columnar epithelium and resembles that of the large intestine, but the intestinal glands are fewer in number and penetrate deeply amongst the lymphoid tissue ***(Borley & Crossman, 2009).***

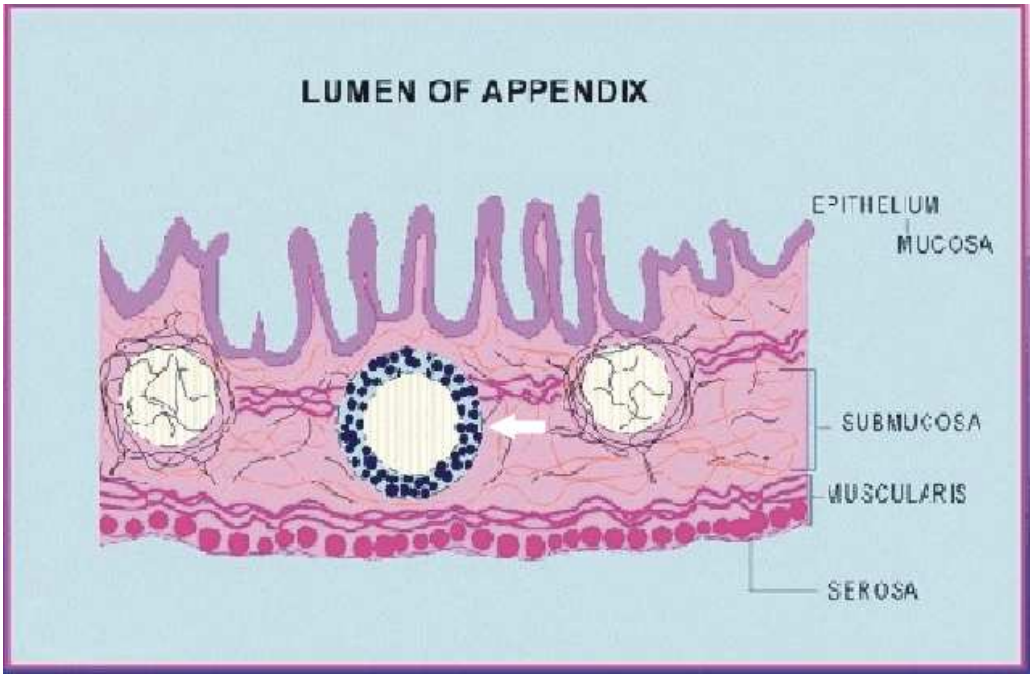


Fig. (5): *Histological structure of the lumen of the appendix .The submucosa contains masses of lymphoid tissue (arrow)* ***(Warwick &Williams, 2009).***

The arterial supply:

The appendicular artery is the main artery to the appendix .It is a branch of the lower division of the ileocolic artery, runs behind the terminal ileum and enters the mesoappendix a short distance from the base of the appendix, here it gives off a recurrent branch which anastomoses at the base of the appendix with a branch of the posterior caecal artery. ***(Ajmani, 2008).***

The appendicular artery runs towards the tip of the appendix, lying at first near to and afterwards in the free border of the mesoappendix [Fig. 6]. The terminal part of the artery; however, lies actually on the wall of the appendix and may become thrombosed in the inflammation of the appendix which may result in gangrene or necrosis of its distal part ***(Ajmani, 2010).***

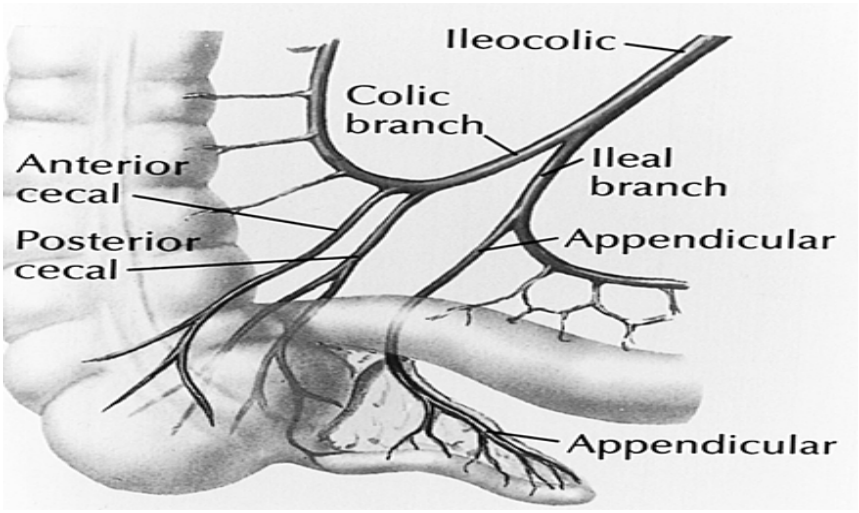


Fig. (6): *Diagram illustrates the blood supply of the cecum and appendix* ***(Simon et al., 2010).***

The Lymphatic Drainage:

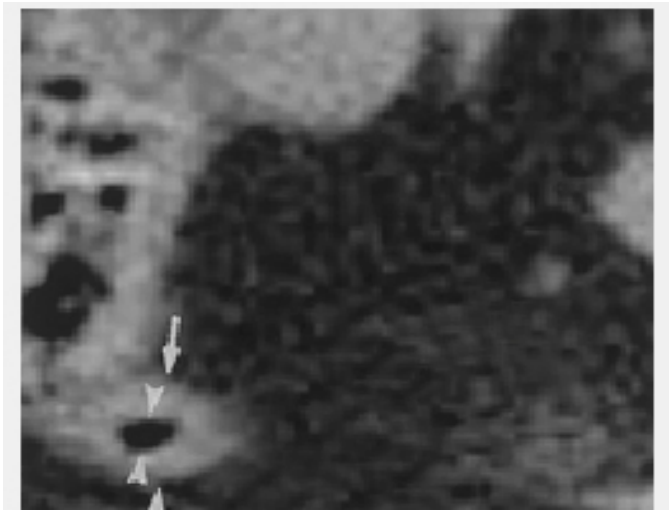
The lymph vessels are numerous, since there is a large amount of lymphoid tissue in the walls**.** From the body and tip of the vermiform appendix eight to fifteen vessels ascend in its mesenteriole, one or two being interrupted by nodes which lie in this peritoneal fold. They unite to form three or four vessels, which end in the lower and upper lymph nodes of the ileocolic chain**.**

The vessels from the root of the vermiform appendix and from the caecum comprise anterior and posterior groups. The anterior vessels pass in front of the caecum, to the anterior ileocolic nodes and the upper and lower nodes of the ileocolic chain. The posterior vessels ascend over the back of the caecum to the posterior ileocolic nodes and the lower nodes of the ileocolic chain ***(Warwick &Williams, 2011).***

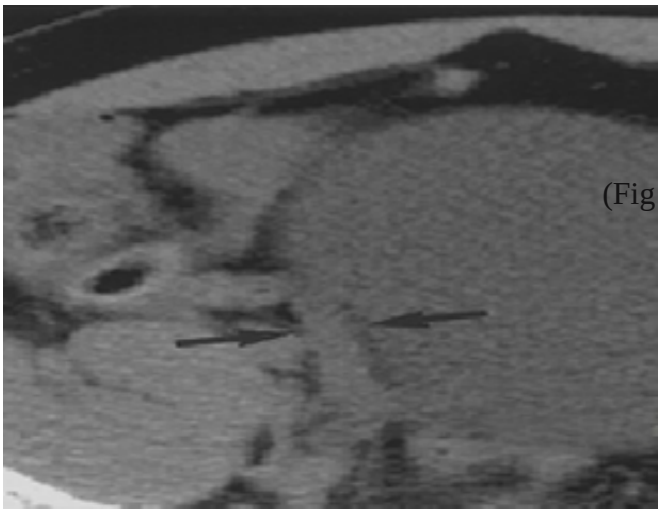
Multislice C.T Appearance of Normal Appendix

In the past decade, CT has evolved as a reliable imaging modality for suspected appendicitis. The increasing accuracy of CT for diagnosing appendicitis has resulted from improvement in CT data acquisition hardware and protocol optimization, enabling more reliable identification of the appendix and detection of the findings that reflect appendicitis ***(Johnson et al., 2009).***

The appendix was interpreted as either visualized or not visualized. The maximum full thickness of the appendix was measured. In a normal appendix, the content may or may not be recognizable, depending on the attenuation of the content. Therefore, it is not possible to differentiate a collapsed appendix from a distended appendix with content of the same attenuation as the wall. The reviewers were asked to measure the maximum thickness of the two walls of the appendix on either side of the content, with exclusion of the content regardless of whether it was fluid or gas if it was recognizable [Fig 7a]. If the content could not be recognized, the maximum full thickness was measured [Fig 7b]. The position of the appendix differs from individual to individual because of the variable location of the caecum and its mobility. Usually, the appendix is found adjacent to the caecal caput, either caudal or posterior to it [Fig 8] ***(Benjaminov et al., 2009).***

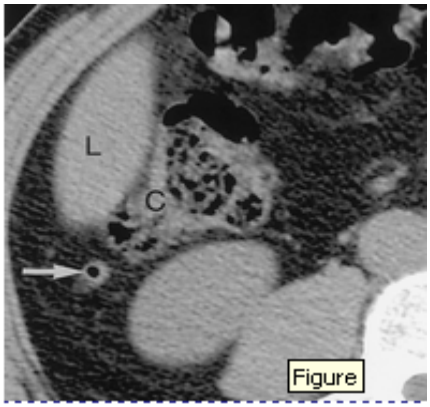


(Fig 7a)

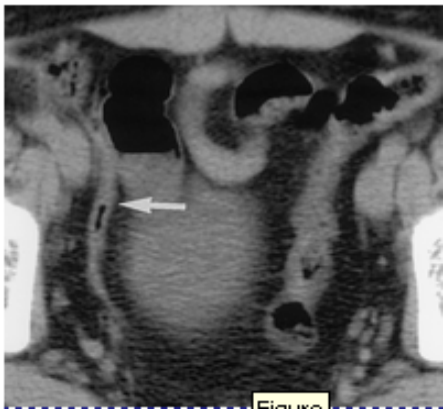


(Fig 7 b)

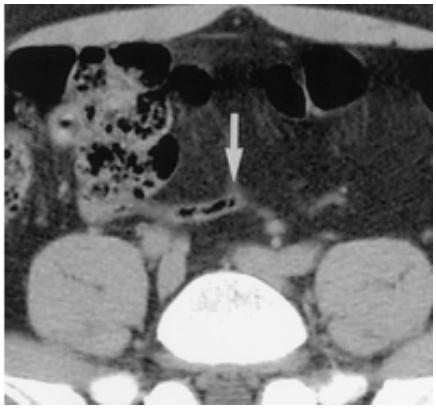
Fig. (7 a& b): *Transverse non enhanced helical CT scans of the abdomen in two patients. (a) The thickness of the wall of the appendix without content is measured by means of subtracting the thickness of air content (arrowheads) from the full thickness (straight arrows). (b) The full thickness of the appendix (arrows) is measured, since the content is not recognizable. This appendix is 8 mm thick* ***(Benjaminov et al., 2012).***



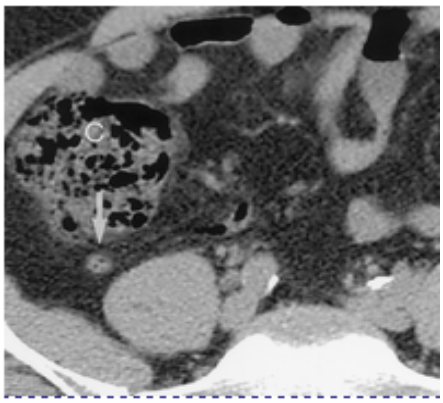
(Fig 8a)



(Fig 8b)



(Fig 8 c)



(Fig 8d)

Fig. (8 a, b, c, d): *Axial non enhanced helical CT scans of the abdomen show different locations of the appendiceal tip (arrow). (a) The appendix extends along the ascending colon (C), with its tip in a paracolic location, inferior to the tip of the right lobe of the liver (L). (b) The appendix extends into the pelvis. (c) The appendix extends medially, with the tip located in the midline. (d) A retrocaecal appendix is located posterior to the cecum (C)* ***(Benjaminov et al., 2012).***