ID: IJARS/2012/4471:0017

Review Article

Radiology Section

Imaging of Appendicitis with Appendicoliths

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ABSTRACT

Appendicitis is one of the commonest causes of acute abdomen all over the world. It is interesting to note that, differences in incidences, sex, age, and seasonal variations have been reported widely. Doubtlessly, it is a surgical disease.

It is etiologically multi-factorial. Advances in diagnosis and treatment, however, has not been matched by advances in etiological understanding. Many questions still remain unanswered like why does it show a familial tendency? Why is it more common in the black races? Why is it lenient on females? Does good hygiene improves your chances of getting appendicitis?

Most central to the enigma called 'Appendicitis' is the accurate imaging based diagnosis so that the further proceedings can be done to relieve the patient of pain and recurrence. Ultrasound of right iliac fossa in right hands, Computerized Tomography (CT) scan and even Magnetic Resonance Imaging (MRI) scan demonstrate an inflamed appendix. Calcifications fit in this picture in the form of Calcified Appendicoliths that block the lumen of appendix and give birth to an initially obstructive but later inflammatory process; which if not treated at correct time might even cause complications like perforation and even death.

Key Words: Appendicitis, Appendicoliths, Imaging, Ultrasound, CT Scan, MRI

INTRODUCTION

Globally, appendicitis is a very common surgical cause of abdominal pain [1, 2]. There are variations in incidences, sex, age, and seasonal affections worldwide. It is common in Caucasians and those from the developed world [3-6].

There is a difference between African and European studies. The estimated population incidences per 100,000 of 18 (Ghana) [7], 36.5 (Central African Republic) [7] versus 132 (Spain) [8], 174 (Ireland) [9], 103 (England) [9], 111 (Scotland) [10], and 123 (Wales) [10]. In South Korea, the figure is 227 [11]. In South Africa, the racial incidence is 5-19 (Blacks) and 215-395 (Whites) per100, 000 [12].

Recent report however highlight increasing incidence in African countries [12-15]. Increased acceptance of western lifestyle, including diets, is believed to be responsible for this [16]. It is more common in males [6, 17-19] and usually occurs in the age range of 10 to 30 years [6, 17-19].

It also has a familial tendency [20-22] and is less common in blacks [12] and in females [23, 24]. A possible explanation is that females generally mount a less intense metabolic response to trauma and infection than males. A poor hygiene has protective benefit on appendicitis [25, 26].

THE PROCESSES AND DETERMINANTS OF ACUTE APPENDICITIS

Appendicitis is more prevalent in the summer months [3, 18]. Some have also reported an excess during spring, suspecting the role of viral infections among others during these months [27]. However, it has been suggested [28] that intense challenge to the mucosa-associated lymphoid tissue from allergens in the dust, during the sandstorms of the Spring months, in the Arabian Peninsula might also play some role.

There is an inverse relationship between the length of infant breast-feeding and the risk of subsequent appendicitis as observed in an Italian study [29]. It is to be noted that the African infants tend to be breastfed throughout the first year (unlike their European counterparts) which would suggest the protective nature of maternal immunoglobulin in breast milk on intestinal infections.

Attempts have been made to study the genetic basis and im-

munological response to appendicitis. In the first study [30], the levels of pro-inflammatory (TNF-α, IL-1β, IFN-γ and IL-12) and anti inflammatory (IL-4, IL-6, IL-10 and IL-1Ra) cytokines in plasma and peritoneal fluids (PF) in histologically proven cases of appendicitis were compared. It showed inverse relationship between the PF and plasma levels of the pro and anti-inflammatory cytokines. It was found that IL-6 and IL-1Ra were the most abundant in plasma and PF with elevations of IL-4 and IL-10 while TNF-α, IL-1β, IFN-γ and IL-12 were low. It was also observed that Il-6 and IL-10 directly corelated with severity of appendicitis. In another study [31] on single nucleotide polymorphism in the IL-6 gene, an association was found with the severity of appendicitis even after adjustment for duration of symptoms was made. This finding, and another from Harvard Medical School, [32] strengthens the genetic basis for appendicitis.

It has been noted that [33] there is an increased numbers of eosinophils in muscle in cases of appendicitis. When link between serum eosinophilic cationic protein (ECP) levels in cases of appendicitis was evaluated in comparison to healthy and pathological controls (asthma); a direct and significant relationship between serum ECP and appendicitis was found.

A study from Sweden [34] on the incidence of appendectomy among monozygotic (3441) and dizygotic (2429) twins concluded that genetic and environmental factors account for 30% and 70% of the association, respectively.

The improvements in hygiene consequent on improved housing, water supplies, and sanitation greatly reduced exposure of young children to enteric organisms, as shown by the fall in childhood mortality from diarrheal disease. It was postulated that this altered the response to subsequent infections in such a way that they cause acute appendicitis [25].

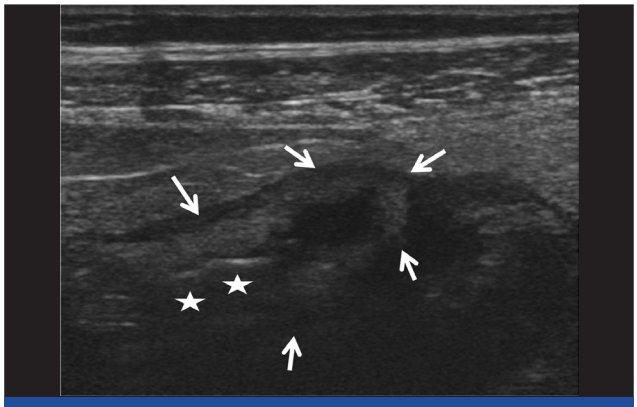
It has therefore been postulated that appendicitis is primarily caused by Western housing rather than by Western diet. This explains the international distribution of the disease which is one of industrialized communities. It also explains the rarity of the disease in blacks in South Africa despite their adoption of aspects of Western lifestyle, including low consumption of fiber. It predicts that communities in which children still grow up in conditions of Third World hygiene will experience outbreaks of appendicitis when housing improves [26].

While Western diet and a mechanistic perspective will continue to be blamed by some of the investigators including world-renowned surgeons [35-37]; the balance of available evidence suggests that appendicitis is an immunological disease regardless of luminal contents.

But neverth less, there is an important role of an appendicolith which usually is a calcified entity that sets the ball of inflammation rolling. A calcified appendicolith stuck up at the caeco-appendicial junction blocks the drainage of secretions and contents from the lumen of appendix into the caecum. Slowly the intraluminal pressure builds up. A softer appendicolith may sometimes yield to these pressures, may breakdown and allow the lumen to empty. But when these appendicoliths are calcified; they achieve strength and do not break under pressure; so that the appendix gets swelled and inflammation ushers in. Calcification imparts such strength to the appendicolith that sometimes the tip of appendix bursts under pressure, but the appendicolith at base remains undaunted.

Hence it is important to diagnose an appendicolith at the earliest when a clinical suspicion of acute appendicitis is made. On ultrasound, calcified appendicolith is seen as a hyper echoic focus at caeco-appendicial junction [Table/Fig-1,2 & 3]. Rarely; it may be seen on plain radiograph of abdomen [Table/Fig-4]. Pelvic CT scan [Table/Fig-5] and MRI can demonstrate not only the appendicolith but the status of appendix as well whether it is perforated or if any appendicular lump has formed.

[Table/Fig-1]: Inflammed Appendix (arrows) and calcification at its Base (star)



[Table/Fig-2]: Inflammed Appendix (arrows) and calcification at its Base (star)

[Table/Fig-3]: Inflammed Appendix (arrows) and calcification at its Base (star)

[Table/Fig-4]: Plain Radograph of Abdomen showing a large calcified Appendicolith

[Table/Fig-5]: Non Contrast C T Scan of Pelvis showing a calcified Appendicolith in Ruptured Appendicular Abscess

The intestinal parasites common in the developing world; also account for some cases of appendicitis, as it has been noticed to be initiated by or associated with them. The commonly associated parasites are Schistosoma mansoni, haematobium, Enterbious vermicularis, Ascaris, Entamoeba histolytica, and pin worm, among others [38, 39].

THE HEALTH IMPACTS OF ACUTE APPENDICITIS

Appendicitis is generally a disease of young age with highest incidence reported in the second and third decades of life [3].

Although high-carbohydrate, low-fiber diets, confectionaries, and sweets are implicated by some authors [40. 41], and a higher incidence is noted in summer months by many authors [3, 19]; It appears that heterogenous extrinsic factors such as, humidity, allergens, sun radiation, and viral and bacterial infections have a role in the etiopathogenesis of appendicitis. But central to them all is the prerequisite that the lumen of appendix be blocked and that it be blocked by something with sufficient strength so as to enable building up of immense pressure in its lumen which ultimately inflames the appendix and might also perforate it if not managed on time.

Calcified appendicolith and its timely radiological diagnoses are hence important in the pathogenesis as well as timely management of this entity. Adverse health impacts following perforation due to an unyielding calcified appendicolith at the junction of caecum and appendix are disastrous for the patients in physical as well as financial terms. Prompt surgical intervention is an effective alternative to conservative therapy as it reduces total hospital stay and obviates the need for subsequent admissions [42]. In fact the treatment of appendicular lump is changing from initial conservative treatment followed by interval appendectomy; to immediate laparoscopic appendectomy on admission [43, 44].

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FINANCIAL OR OTHER COMPETING INTERESTS:
None.

Date Of Submission: **May 05, 2012**
Date Of Peer Review: **May 20, 2012**
Date Of Acceptance: **Jun 12, 2012**
Date Of Publishing: **Jun 25, 2012**