

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



# Faecoliths in Appendicitis: Does It Influence the Course and Treatment of the Disease in the Acute Setting?

Rossi Adu-Gyamfi

## Abstract

Luminal obstruction has been widely considered as one of the major causes of appendicitis. Faecolith, in this case called appendicolith, is a hardened lump of faeces in varying sizes, have over the years been closely associated with appendicitis as a potential cause of luminal obstruction. There are varying opinions with regards to role of appendicolith in both uncomplicated and complicated acute appendicitis. While some authors have reported that the presence of appendicolith is a predictive factor for high failure rates, others are of the opinion that appendicolith does not necessarily predict non-operative treatment failure, and even if so, not as an independent factor. Opinions also seem to be divided on the correlation between complicated appendicitis and the presence of appendicolith. This chapter seeks to discuss the evidence available and attempt to clarify the controversies surrounding the role of appendicolith in acute appendicitis using current evidence available.

**Keywords:** Faecolith, Appendicitis

## 1. Introduction

There are numerous theories with regards to the aetiology of acute appendicitis. These theories include genetic factors, environmental influences, luminal obstruction and infections. However, of all these theories, the debate between luminal obstruction with possible secondary infective process and primary infective causes has been the fiercest. With the latter raising more questions than answers.

Even though many infectious agents have been linked with acute appendicitis, quite a number of them are still unknown and this makes the understanding of the pathophysiology even more difficult [1–3]. In addition to the aforementioned, most organisms isolated from patients are typically normal colonic flora and that is in sharp contrast to the original postulation of the temporal and geographic distribution of organisms.

Luminal obstruction of the appendix results from a variety of causes and is associated with increased pressure within the lumen. Causes of appendiceal luminal obstruction include lymphoid hyperplasia due to inflammatory bowel disease or infections (commonly viruses), parasites, foreign bodies, neoplasms and faecoliths. The increased pressure results from continuous secretion and stagnation of fluids

and mucus from the mucosal epithelial cells. This serves to provide a conducive milieu for intestinal flora to multiply and flourish. This multiplication leads to local increase in bacteria load, with its accompanying translocation and the subsequent inflammatory process which ensues, resulting in the formation of pus and a further increase in intraluminal pressure.

Appendiceal venous outflow obstruction occurs as the intraluminal pressure rises above the appendiceal venous pressure. A further increase in luminal pressure also impairs arterial blood flow to the appendix. The above-mentioned vascular compromise gives rise to a loss of epithelial integrity and wall ischaemia, which in addition to the luminal bacteria overgrowth, and rapid bacteria translocation are often complicated by peritonitis, perforation, gangrene of the appendix and/or peri-appendicular abscess with or without peritonitis.

## **2. Faecoliths as a causal agent of acute appendicitis**

Faecolith, also known as appendicolith, appendiceal calculi/enterolith or corporolith, is a combination of firm, dense stool and mineral or calcified deposits which usually has a laminar structure [4]. Although the formation of a faecolith is not clearly understood, there have been previous instances where foreign bodies and gallstones have been implicated [5, 6]. As a matter of fact, for a long time, there was a myth which seemed to have suggested that accidental swallowing of seeds could cause acute appendicitis.

Early on, faecoliths were noted to be one of the most common causes of acute appendicitis resulting from luminal obstruction. In the early 19th century Volz observed faecoliths to be a “pathognomonic agent” for typhlitis [7]. Later that century, Fitz revealed that in patients who presented with perforated appendicitis, 47% of them had hardened stools in the lumen of the appendix [8]. These findings raised enough suspicions which linked faecoliths to acute appendicitis and possibly its complicated forms. As a result, many other observations were published [9–11]. Most of these studies, however, remained experimental until Bowers conclusively showed in the late 1930s that obstruction by a faecolith was a major cause of acute appendicitis [12].

The other issue with respect to faecoliths in acute appendicitis has to do with its consistency. This has led to the suggestion that faecoliths should be classified based on consistency and calcium content due to their correlation with perforation. On the contrary, other authors have also suggested that even the softer form presents more commonly with appendicitis than the harder ones [13, 14].

In fact, the prevalence of faecoliths in the vermiform appendix has been recently reported to be 3% in a population study by Jones et al. [15]. In this study, the investigators observed an increased incidence in populations with increased intake of low-fibre diets. Other studies have shown higher prevalence in paediatric and young adult population, with increased male preponderance [16]. There are also reports of increased incidence of faecoliths among patients with a retrocaecal appendix, but these are yet to be substantiated.

From the discussions so far, it can therefore be concluded that the presence of faecoliths does not confirm a diagnosis of acute appendicitis without the presence of appendiceal wall inflammation involving the muscularis propria on histological assessment or peri-caecal inflammatory changes/appendiceal wall enhancement clinically. On this matter, there have been numerous conflicting reports on the relationship between the presence of faecoliths and appendicitis especially in different age groups [17–19]. There are reports by some authors that up to 49% appendices with luminal obstruction were normal on histological assessment. The same study

also found that 49% of appendices with luminal obstruction had microscopic evidence of acute inflammation even though they looked normal macroscopically. Some of these studies initially led to the performance of an appendectomy in asymptomatic patients with a faecolith by some surgeons. This practice, however, is currently controversial. At the moment, the widely accepted evidence is what Butler et al. [20] reported. They found faecoliths in 10% of patients, with 90% of them subsequently going on to develop appendicitis. The purpose of this chapter is however to look at the effect of faecoliths on the disease process of acute appendicitis.

The discussion on the role of faecoliths in appendicitis, in general, could be as old as the disease process itself and as result many theories have been postulated in times past. This chapter will be broken down into subheadings on important aspects of the role of faecoliths in acute appendicitis.

### **3. Incidence and diagnosis**

The incidence of faecoliths in population and patient studies have been generally discussed in previous paragraphs of this chapter. With the introduction of modern abdominal imaging modalities from plain abdominal radiography, ultrasound examination, computed tomography (CT) scan to magnetic resonance imaging, the association of faecoliths as an important cause of luminal obstruction in acute appendicitis have become very clear and recent data reports prevalence of about 20% in pathological specimens either with or without the presence of acute appendicitis.

Faecoliths are usually one the main causes of non-specific intermittent abdominal pain. In some cases, it even mimics genitourinary conditions such as urolithiasis. They are usually less than a centimeter in diameter and those that are more than two-centimeters are classified as giant faecoliths. Even though those greater than two-centimeters are considered uncommon, the largest ever recorded is 3.5 cm [21, 22].

A study by Ishiyama et al. [23] to investigate the significance of appendicoliths as an exacerbating factor of acute appendicitis using multivariate analysis resulted in very interesting findings. First of all, they were able to show that the presence of a faecolith is usually associated with more severe disease. In addition, the study identified a significant relationship between severe disease and size, and location of the faecolith. The larger the size and/or the more proximal the location in the vermiform appendix, the more likelihood of severe disease. The radiological characteristics of faecoliths associated with acute appendicitis were recently described by Khan [24]. He and his colleagues concluded that, in addition to a faecolith of 5 millimetres or more, multiple faecoliths were also identified to be an independent factor associated with acute appendicitis.

The diagnosis of acute appendicitis in a patient who presents with abdominal pain has markedly improved with the advent of numerous imaging modalities. In the presence of a faecolith, an abdominal plain radiography study alone can be considered as adequate when there is associated abdominal pain, with a specificity of 100% [25]. The use of CT scans in the assessment of patients suspected to have appendicitis has shown that the incidence of faecoliths is higher in the general population than previously reported. Two studies by Balthazar et al. and Rao et al. reports of incidence between 43 and 50% in predominantly adult patients diagnosed with acute appendicitis [26, 27]. In the paediatric population, Lowe and her friends showed that the incidence of faecoliths in patients with confirmed acute appendicitis was 65% [28]. This detection rate could be diminished by the administration of oral contrast. CT scans have been extensively used in the diagnosis of acute appendicitis.

At the time of writing this chapter, there was no study or literature dedicated to the diagnostic capabilities of ultrasound (US) scan in faecolith-related acute appendicitis. However, in general, the accuracy of US scan in the diagnosis of acute appendicitis is between 71–95% with sensitivity and specificity of 94.7% and 88.9% respectively when graded compression ultrasonography is done [29, 30]. Magnetic Resonance Imaging (MRI) has the advantage of no ionizing radiation exposure and the absence of nephrotoxic contrast agents. Availability and cost are among the main reasons why it is underutilised, although it has a sensitivity and specificity of 96.8% and 97.4% respectively. At the moment, there is very little data on its role and position in the workup of appendicitis, except in very special circumstances [31].

#### **4. Role of faecoliths in disease presentation and failure of conservative treatment**

Literature on what role and effect faecoliths have on clinical scoring systems in acute appendicitis was very scanty to come by and therefore this chapter cannot provide a comment on that currently. Nonetheless, some studies, like that of Ishiyama and colleagues as mentioned in the previous paragraph have observed severe disease presentations in patient with faecoliths compared to those without.

In addition, faecoliths have been known to be more frequently associated with perforations and abscess formation [32]. Flum et al. found that the presence of faecoliths was identified to be a significant contributor of post treatment complications and adverse effects in patients who received antibiotics alone compared with those who had surgery. They also realised that though the perforation rate was high in patients initially treated with antibiotics, this high rate was attributable to patients with a faecolith. They reported about a 3-fold rise in perforations among the faecolith group. This, however, did not lead to a higher rate of extensive resections in the antibiotic group. Looking at the group that had appendicectomy done as initial treatment, there was not much difference in the perforation rate between patients with faecoliths and those without.

As a result, the finding of an appendicolith may be sufficient evidence to perform an appendectomy in patients earmarked for conservative management, given the higher rate of perforation at the time of failure of antibiotic treatment. This position is so explicitly stated in the recommendations made in the Jerusalem guidelines of 2020 and seems to be consistent with what Von and his friends found. It is however the author's strong believe that every patient's situation should be uniquely assessed, and a tailored treatment advocated with the patient's express consent of course.

#### **5. Effect on treatment and complications**

In the management of acute uncomplicated appendicitis using laparoscopy, Finnerty et al. [33] showed that age, presence of diabetes, raised BMI, presence of imaging confirmed complicated appendicitis, male gender and ethnicity were independent predictor of failure in laparoscopic management of acute uncomplicated appendicitis. At the moment, there is no evidence to support which method of treatment is best in the presence of faecolith in acute uncomplicated appendicitis, even though current evidence favours laparoscopy in the management of uncomplicated acute appendicitis generally. The presence of faecolith has been shown to have significant effect on therapeutic interventions and therefore the treating surgeon must be informed about the presence of faecolith for certain considerations



to be taken into account. For instance, there have been several studies and case reports to show that dropped faecolith is a major contributor of post interventional morbidity with increased incidence of pelvic abscesses especially after laparoscopic appendectomy.

The results from the CODA trial showed a noninferiority in managing patient with acute appendicitis conservatively with antibiotics in terms of 30-day post treatment health status, which was the primary outcome of the study. At 90-day post treatment, 29% of patients in the antibiotic arm had undergone appendectomy. When a subgroup analysis was done, the number of patients with faecolith who required appendectomy in the antibiotic group was almost twice patients without faecolith in the same subgroup. Even though all these are evolving areas of controversy, the surgeon's awareness of the presence of faecolith is key to enable adequate decision making and planning for possible retrieval of faecolith if so needed [32, 34, 35].

## **6. Faecolith as a predictor for extensive resection**

The Gridiron incision, also known as McBurney's incision, is the most commonly used open method in the management of acute uncomplicated appendicitis. In addition to this type of incision offering a minimally invasive and direct access to the diseased appendix, it provide good cosmesis and in lean (healthy BMI) patients, it is usually comparable to laparoscopic technique in terms of access, time of surgery, hospital stay and cosmetic advantage. In situations of delayed presentation or complications, McBurney's technique becomes extremely challenging and, in such situations, larger laparotomy incisions are made with accompanied extensive bowel resection in some cases. The most common extensive bowel resection in acute appendicitis is ileocaecectomy with or without primary anastomosis of bowel. Recent evidence suggests that appendiceal mass, non-visualization of appendix, delayed admission, and CRP are strong predictors of extensive resection in acute appendicitis [36]. Additionally, faecolith was also identified as a preoperative predictor of extensive resection for acute appendicitis. Other preoperative predictors of extensive resection found in these studies included age, ascites, and extraluminal air. The role of faecolith in predicting the possibility of extensive resection obviously require further robust research but should not be underestimated.

## **7. Role of routine interval appendectomy in the presence of faecoliths**

Consensus on routine interval appendectomy after conservative management of acute appendicitis is another highly debated subtopic in acute appendicitis. As a principle, surgeons are more inclined to do routine interval appendectomy especially in patients in their mid-forties and above as there is an increased risk of malignancy in this groups. However, one can question the essence of this practice especially when there are very accurate diagnostic imaging modalities available to assist with confirming the presence of a tumour. While some have argued for routine interval appendectomy when a faecolith is involved because of its possible association with increase recurrence rate, others have suggested otherwise as there have not been adequate evidence to support this idea especially when patients remained asymptomatic [37, 38].

To conclude, the role of faecoliths in causing acute appendicitis, and not just the disease but the worse form of it cannot be underestimated. Its ability to accelerate complications in the disease process and in addition cause significant headaches for

surgeons and patients cannot be in dispute. The several contrasting opinions with regards to what to do with it confirms how complicated the situation is. It is the author's firm opinion that more focused research should be done on this subject. Also, a lot of commendations should go to the designers and authors of the CODA trial who have thrown more light on this subgroup of patients.

### **Author details**

Rossi Adu-Gyamfi<sup>1,2</sup>

1 Division of Surgery, Stellenbosch University/Tygerberg Academic Hospital, Cape Town, South Africa

2 Division of Surgery, 37 Military Hospital, Accra, Ghana

\*Address all correspondence to: drpaoloross@gmail.com

### **IntechOpen**

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

## References

- [1] Lamps LW. Infectious causes of appendicitis. *Infect Dis Clin North Am* 2010; 24: 995-1018.
- [2] Dzabic M, Bostrom L, Rahbar A. High prevalence of an active cytomegalovirus infection in the appendix of immunocompetent patients with acute appendicitis. *Inflamm Bowel Dis* 2008; 14: 236-41.
- [3] Carr NJ. The pathology of acute appendicitis. *Ann Diagn Pathol* 2000; 4: 46-58.
- [4] Felson B, Bernhard CM. Roentgenologic diagnosis of appendiceal calculi. *Radiology* 1947; 49:178-91.
- [5] Mehrotra PK, Ramachandran CS, Gupta L. Laparoscopic management of gallstone presenting as obstructive gangrenous appendicitis. *J Laparoendosc Adv Surg Tech A* 2005; 15:627-9.
- [6] Moorjani V, Wong C, Lam A. Ingested foreign body mimicking an appendicolith in a child. *Br J Radiol* 2006; 79:173-4.
- [7] Volz A. Die durch Kothsteine bedingte Durchbohrung des Wurmfortsatzes, die häufig verkannte Ursache einer gefährlichen Peritonitis, und deren Behandlung mit Opium. Carlsruhe, Germany: CF Müller; 1846.
- [8] Fitz RH. Perforating inflammation of the vermiform appendix. *Am J Med Sci* 1886; 92: 321-346.
- [9] Van Zwahlenburg C. The relation of mechanical distention to the etiology of appendicitis. *Ann Surg* 1905; 41: 437-450.
- [10] Van Zwahlenburg C. Appendicitis: some points in its diagnosis and treatment from the view-point that its cause is a strangulation produced by distension behind a ball-valve. *Cal State J Med* 1905; 3: 14-16.
- [11] Wangensteen OH, Dennis C. Experimental proof of the obstructive origin of appendicitis in man. *Ann Surg* 1939; 110: 629-647.
- [12] Forbes GB, Lloyd-Davies RW. Calculous disease of the vermiform appendix. *Gut*. 1966; 7: 583-592.
- [13] Sgourakis G, Sotiropoulos GC, Molmenti EP et al. Are acute exacerbations of chronic inflammatory appendicitis triggered by coprostasis and/or coproliths? *World J Gastroenterol* 2008; 14: 3,179-3,182.
- [14] Bowers WF. Appendicitis with especial reference to pathogenesis, bacteriology and healing. *Arch Surg* 1939; 39: 362-422.
- [15] Jones BA, Demetriades D, Segal I, Burkitt DP. The prevalence of appendiceal fecaliths in patients with and without appendicitis. A comparative study from Canada and South Africa. *Ann Surg*. 1985; 202:80-2.
- [16] Nitecki S, Karmeli R, Sarr MG. Appendiceal calculi and fecaliths as indications for appendectomy. *Surg Gynecol Obstet*. 1990; 171:185-8.
- [17] Huwart L, El Khoury M, Lesavre A, Phan C, Rangheard AS, Bessoud B et al. Is appendicolith a reliable sign for acute appendicitis at MDCT? *J Radiol* 2006; 87:383-7.
- [18] Jabra AA, Shalaby-Rana EI, Fishman EK. CT of appendicitis in children. *J Comput Assist Tomogr* 1997; 21:661-6.
- [19] Aljefri A, Al-Nakshabandi N. The stranded stone: Relationship between



acute appendicitis and appendicolith. Saudi J Gastroenterol 2009;15:258-60

[20] Butler P, Mitchell A, Healy JC. Applied Radiological Anatomy. Cambridge University Press. (2012) ISBN:0521766664.

[21] Keating JP, Memon S. Giant appendicolith. Gastrointest Endosc 2005; 61:292-3.

[22] Felson B, Bernhard CM. Roentgenologic diagnosis of appendiceal calculi. Radiology 1947; 49:178-91.

[23] Ishiyama M, Yanase F, Taketa T, Makidono A, Suzuki K, Omata F, et al. Significance of size and location of appendicoliths as exacerbating factor of acute appendicitis. Emerg Radiol 2013; 20:125-30.

[24] Khan M, Chaudhry M, Shahzad N, et al. (August 05, 2019) The Characteristics of Appendicoliths Associated with Acute Appendicitis. Cureus 11(8): e5322. DOI 10.7759/cureus.5322

[25] Kirks DR. The gastrointestinal tract. In: Practical pediatric imaging: diagnostic radiology of infants and children. Philadelphia: Lippincott-Raven, 1995:945-952

[26] Balthazar EJ, Birnbaum BA, Yee J, Megibow AJ, Roshkow J, Gray C. Acute appendicitis: CT and US correlation in 100 patients. Radiology 1994; 190:31-35

[27] Rao PM, Rhea JT, Novelline RA. Sensitivity and specificity of the individual CT signs of appendicitis: experience with 200 helical appendiceal CT examinations. J Comput Assist Tomogr 1997;21: 686-692

[28] Lowe LH, Penney MW, Schecker LE, Perez Jr. R, Stein SM, Heller RM, Shyr Y, Hermanz-Schulman M. Appendicolith Revealed on CT in Children with

Suspected Appendicitis: How Specific Is It in the Diagnosis of Appendicitis? AJR 2000; 175:981-984

[29] Rao PM, Boland GWL. Imaging of acute right lower abdominal quadrant pain. Clin Radiol 1998; 53:639-49.

[30] Douglas CD, Macpherson NE, Davidson PM, Gani JS. Randomised controlled trial of ultrasonography in diagnosis of acute appendicitis, incorporating the Alvarado score. BMJ 2000; 321:1-7

[31] Kulaylat AN, Moore MM, Engbrecht BW, et al. An implemented MRI program to eliminate radiation from the evaluation of pediatric appendicitis. J Pediatr Surg 2015;50(8):1359-63.

[32] Flum DR, Davidson GH, Monsell SE, et al. A Randomized Trial Comparing Antibiotics with Appendectomy for Appendicitis: The CODA Collaborative. NEJM 2020; 383(20): 1907-1919

[33] Finnerty BM, Wu X, Giambrone GP, Gaber-Baylis LK, Zabih R, et al. Conversion-to-open in laparoscopic appendectomy: A cohort analysis of risk factors and outcomes. International Journal of Surgery. 2017;40: 169-175

[34] Itah R, Skornick Y, Greenberg R. Extraluminal appendicolith: An indication for interval appendectomy with intraoperative localization and removal of that potential cause of intra-abdominal abscess. J Laparoendosc Adv Surg Tech A 2008; 18:606-8.

[35] Singh AK, Hahn PF, Gervais D, Vijayraghavan G, Mueller PR. Dropped appendicolith: CT findings and implications for management. AJR Am J Roentgenol 2008; 190:707-11.

[36] Saida F, Matsumoto S, Kitano M. Preoperative predictor of extensive

resection for acute appendicitis. The  
American Journal of Surgery.  
2018;215: 599-602

[37] Rushing A, Bugaev N, Jones C, MD,  
Como JJ, Fox N, et al. Management of  
acute appendicitis in adults: A practice  
management guideline from the Eastern  
Association for the Surgery of Trauma.  
J Trauma Acute Care Surg. 2019;87:  
214-224.

[38] Vons C, Barry C, Maitre S,  
Pautrat K, Leconte M, Costaglioli B,  
Karoui M, Alves A, Dousset B, Valleur P,  
et al. Amoxicillin plus clavulanic acid  
versus appendectomy for treatment of  
acute uncomplicated appendicitis: an  
openlabel, noninferiority, randomized  
controlled trial. Lancet. 2011;377:  
1573-1579.