



Defining the Disease: Uncomplicated Versus Complicated Appendicitis

2

Christie Buonpane and Seth Goldstein

Case Example

An 11-year-old girl is undergoing a laparoscopic appendectomy. Intraoperatively the surgeon notes a fibrinous exudate on the appendix and murky fluid in the pelvis but not frank hole in the appendix. Do these intraoperative findings provide sufficient detail to define this as a case of uncomplicated or complicated appendicitis? And will this affect postoperative management?

Introduction

The nomenclature used to describe appendicitis has been debated for decades. Many postulate that appendicitis has a temporal progression, starting with simple uncomplicated disease, which, left untreated, will progress to perforation [1]. Others suggest that perforated and non-perforated appendicitis have different pathophysiology, and many episodes of uncomplicated appendicitis will spontaneously resolve without development of perforation [2]. Clinical treatment pathways and patient outcomes differ between uncomplicated and complicated appendicitis; however, a lack of consensus or standardization for the definition currently exists.

Terminologies such as “uncomplicated versus complicated,” “non-perforated versus perforated,” and “simple versus complex” are often used to describe appendicitis (Fig. 2.1). The reported incidence of complicated appendicitis ranges dramatically from 20% to 76%, which is likely due to the lack of standardization in the definition [3]. The strictest definition of complicated appendicitis only includes patients with a visible hole in the appendix or fecalith in the abdomen [4, 5].

C. Buonpane (✉) · S. Goldstein

Ann & Robert H. Lurie Children’s Hospital of Chicago, Chicago, IL, USA

Northwestern University, Chicago, IL, USA

e-mail: Cbuonpane@luriechildrens.org

© Springer Nature Switzerland AG 2019

C. J. Hunter (ed.), *Controversies in Pediatric Appendicitis*,

https://doi.org/10.1007/978-3-030-15006-8_2

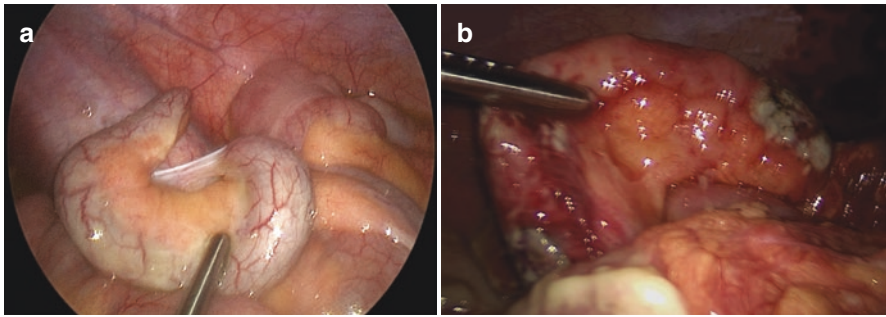


Fig. 2.1 (a) Intraoperative view of uncomplicated appendicitis. The appendix appears enlarged and hyperemic. (b) Intraoperative view of complicated appendicitis. Two focal areas of perforation can be seen, both at the base and tip of the appendix

Table 2.1 A summary of the various definitions of complicated appendicitis utilized in the current literature

Definitions of complicated appendicitis	
Fallon et al. [7] Retrospective review	“Gangrenous appendicitis has an ischemic, discolored wall without evidence of a hole or frank pus. Perforated appendicitis includes those with a hole, frank pus, or a fecalith”
	“Acute necrotizing/gangrenous appendicitis is acute appendicitis + any focus of transmural myonecrosis of the muscularis propria with an intact serosa. Perforations can be gross or microscopic”
Li et al. [8] Systematic review	“Gangrenous appendicitis, perforated appendix without phlegmon or abscess, or perforated appendicitis with phlegmon or abscess”
Yau et al. [9] Retrospective review	“Operative findings of gangrenous or perforated appendix with or without abscess formation”
Vaos et al. [10] Meta-analysis	“Operative findings of a perforated appendix according to the surgeon’s diagnosis, or a periappendicular abscess or phlegmon, or appendiceal perforation confirmed in pathology report”
Varadhan et al. [11] Meta-analysis	“Local or contained perforation with an appendicular abscess or mass”
Athanasiou et al. [12] Systematic review	“Histologically or intraoperatively diagnosed perforated appendix with or without free or localised pus or gangrenous appendix”
Meta-analysis	
Fraser et al. [13] Prospective randomized trial	“Perforation was defined as an identifiable hole in the appendix or a fecalith in the abdomen”

All other patients, including a broad spectrum of disease, would be categorized as uncomplicated. Other classification systems consider suppurative/phlegmonous findings as uncomplicated and necrotic/gangrenous/perforated/ abscess as complicated [6]. A wide variability exists in the definitions utilized in appendicitis studies. Table 2.1 provides examples of various definitions of complicated appendicitis used in the literature [7–13].

The postoperative clinical pathway, patient outcomes, and morbidity differ dramatically between uncomplicated and complicated appendicitis [7]. Appropriate categorization of patients with complicated appendicitis is important in order to employ the proper treatment pathway and reduce the risk of postoperative abscess formation and other associated complications. St. Peter et al. demonstrated that a strict definition of complicated appendicitis (visible hole in the appendix or a fecalith in the abdomen) is effective in identifying patients at risk for postoperative abscess formation and would avoid overtreatment in patients with purulent or gangrenous appendicitis [4]. Analysis of patients with gangrenous appendicitis showed that outcomes and morbidity rates resemble those of simple appendicitis and that treatment should follow the uncomplicated clinical pathway [14, 15]. Others believe that patients with gangrenous appendicitis should be treated as complicated disease [6]. Standardization of these terms is crucial in order to reliably study patient outcomes in appendicitis and to avoid overtreatment of patients and prolonged hospital stays.

The definition of uncomplicated versus complicated appendicitis may be chosen from intraoperative findings, histopathology results, or a combination of both. However, postoperative clinical management is often dictated by intraoperative findings and employed prior to histopathology results. Intraoperative classification of appendicitis by the operating surgeon is often specific to the individual and can vary within a department and between institutions. Van den Boom et al. found considerable inter-observer variability exists in the intraoperative classification of appendicitis [16]. Additionally, there is an 8–10% discrepancy between intraoperative classification and the histopathologic diagnosis [7]. Often, intraoperative findings dictate postoperative management, and pathology results are used for official ICD-9 billing diagnoses. The application of retrospective review findings in clinical practice is complicated by these discrepancies.

Conclusion

Although appendicitis has been recognized for over a century, a lack of standardization in defining the disease still exists today. The definition of uncomplicated versus complicated appendicitis is crucial due to its impact on clinical decision making and patient outcomes. Proper definition of the disease could have direct effects on patient quality of care, complication rates, hospital costs, and length of stay. In the case example, fibrinous exudate and murky fluid are found intraoperatively, but without a frank hole in the appendix. In our opinion, this patient should be classified as having uncomplicated appendicitis, and postoperative care should follow the uncomplicated clinical pathway. This will avoid overtreatment with prolonged antibiotics and shorten hospital length of stay without increasing the risk of postoperative abscess formation or other complications [4, 17].

In addition to effects on patient quality of care and outcomes, the strict categorization of uncomplicated and complicated appendicitis has a vast effect on the ability of different institutions to compare results and study appendicitis outcomes. Due to

the different interpretations and definitions of appendicitis, data published may be unreliable because of the ill-defined denominator [4]. In order to properly study the disease and allow for institutions to compare results in a meaningful way, standardization of the definition must exist.

Clinical Pearls

- A lack of standardization in the definition of appendicitis still exists today.
- Treatment pathways differ for uncomplicated and complicated appendicitis.
- Appropriate categorization of appendicitis can have direct effects on patient quality of care and outcomes.

References

1. Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. *World J Surg.* 2007;31(1):86–92.
2. Atema JJ, van Rossem CC, Leeuwenburgh MM, Stoker J, Boermeester MA. Scoring system to distinguish uncomplicated from complicated acute appendicitis. *Br J Surg.* 2015;102(8):979–90.
3. Newman K, Ponsky T, Kittle K, Dyk L, Throop C, Gieseker K, et al. Appendicitis 2000: variability in practice, outcomes, and resource utilization at thirty pediatric hospitals. *J Pediatr Surg.* 2003;38(3):372–9; discussion 9.
4. St Peter SD, Sharp SW, Holcomb GW 3rd, Ostlie DJ. An evidence-based definition for perforated appendicitis derived from a prospective randomized trial. *J Pediatr Surg.* 2008;43(12):2242–5.
5. Rentea RM, St Peter SD. Pediatric appendicitis. *Surg Clin North Am.* 2017;97(1):93–112.
6. Bhangu A, Soreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. *Lancet.* 2015;386(10000):1278–87.
7. Fallon SC, Kim ME, Hallmark CA, Carpenter JL, Eldin KW, Lopez ME, et al. Correlating surgical and pathological diagnoses in pediatric appendicitis. *J Pediatr Surg.* 2015;50(4):638–41.
8. Li Z, Zhao L, Cheng Y, Cheng N, Deng Y. Abdominal drainage to prevent intra-peritoneal abscess after open appendectomy for complicated appendicitis. *Cochrane Database Syst Rev.* 2018;5:CD010168.
9. Yau KK, Siu WT, Tang CN, Yang GP, Li MK. Laparoscopic versus open appendectomy for complicated appendicitis. *J Am Coll Surg.* 2007;205(1):60–5.
10. Vaos G, Dimopoulou A, Gkioka E, Zavras N. Immediate surgery or conservative treatment for complicated acute appendicitis in children? A meta-analysis. *J Pediatr Surg.* 2018 Jul 27. pii: S0022–3468(18)30478–0. <https://doi.org/10.1016/j.jpedsurg.2018.07.017>. [Epub ahead of print].
11. Varadhan KK, Neal KR, Lobo DN. Safety and efficacy of antibiotics compared with appendectomy for treatment of uncomplicated acute appendicitis: meta-analysis of randomised controlled trials. *BMJ.* 2012;344:e2156.
12. Athanasiou C, Lockwood S, Markides GA. Systematic review and meta-analysis of laparoscopic versus open appendectomy in adults with complicated appendicitis: an update of the literature. *World J Surg.* 2017;41(12):3083–99.
13. Fraser JD, Aguayo P, Leys CM, Keckler SJ, Newland JG, Sharp SW, et al. A complete course of intravenous antibiotics vs a combination of intravenous and oral antibiotics

- for perforated appendicitis in children: a prospective, randomized trial. *J Pediatr Surg.* 2010;45(6):1198–202.
14. Emil S, Laberge JM, Mikhail P, Baican L, Flageole H, Nguyen L, et al. Appendicitis in children: a ten-year update of therapeutic recommendations. *J Pediatr Surg.* 2003;38(2):236–42.
 15. Shbat L, Emil S, Elkady S, Baird R, Laberge JM, Puligandla P, et al. Benefits of an abridged antibiotic protocol for treatment of gangrenous appendicitis. *J Pediatr Surg.* 2014;49(12):1723–5.
 16. van den Boom AL, de Wijkerslooth EML, Mauff KAL, Dawson I, van Rossem CC, Toorenvliet BR, et al. Interobserver variability in the classification of appendicitis during laparoscopy. *Br J Surg.* 2018;105(8):1014–9.
 17. Emil S, Gaied F, Lo A, Laberge JM, Puligandla P, Shaw K, et al. Gangrenous appendicitis in children: a prospective evaluation of definition, bacteriology, histopathology, and outcomes. *J Surg Res.* 2012;177(1):123–6.