

Why surgeons are not operating on some children with appendicitis

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Deborah S. Loeff, M.D., FAAP; Janice A. Taylor, M.D., FAAP

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Appendectomy, whether laparoscopic or open, has been the mainstay of treatment for appendicitis in children. However, nonoperative management (NOM) is gaining more acceptance as the primary treatment for uncomplicated, acute appendicitis in children who meet specific diagnostic criteria (Minnecci PC, et al. *J Am Coll Surg*. 2014;219:272-279; Hartwich J, et al. *J Pediatr Surg*. 2016;51:153-158).

Over the past 15 years, much of the dogma regarding evaluation and surgical management of children with appendicitis has been critically evaluated (Newman K, et al. *J Pediatr Surg*. 2003;38:372-379; Muehlstedt SG, et al. *J Pediatr Surg*. 2004;39:875-879). Significant factors driving challenges to appendectomy include parental anxiety about handing their child over to a surgeon and anesthesiologist, economic pressures to limit hospital costs and reduce length of stay, and the need to minimize parental time off work and missed school days for children.

Variations in practices and resources between pediatric and nonpediatric hospitals and rural and urban care settings also may impact treatment choice and outcomes (Rice-Townsend S, et al. *Ann Surg*. 2014;259:1228-1234).

In an age of increasing co-management between surgeons and primary care physicians, it is imperative for members of the health care team to have a clear understanding of the indications and limitations of NOM of appendicitis in children. Educating parents and encouraging their participation in decision-making also are key to ensuring satisfactory outcomes.

What is NOM?

A child with confirmed uncomplicated appendicitis is admitted to the hospital, given intravenous (IV) fluids for hydration and kept NPO until nausea and emesis subside. Single or double agent broad-spectrum IV antibiotics are given until symptoms and exam improve/resolve and diet can be advanced. Analgesics should be used judiciously so as not to mask worsening of pain and fever.

If signs and symptoms resolve (usually within 48 hours), the child may be discharged on oral antibiotics for seven to 10 days with follow-up as an outpatient.

Who is a candidate for NOM?

Typically, the diagnosis of a child with uncomplicated appendicitis is based on duration of symptoms less than 36 hours, a history of periumbilical pain migrating to the right lower abdomen with tenderness and localized peritoneal irritation on exam, nausea, emesis, anorexia, low-grade fever, elevated white blood cell count with a left shift, increased inflammatory markers, and ultrasound imaging demonstrating a non-compressible, tubular structure without a fecalith measuring 0.8-1.1 centimeters in the right lower abdomen. Use of appendicitis scoring systems also may aid identification of uncomplicated vs. perforated appendicitis and the need for more definitive imaging studies.

If an initial ultrasound is equivocal or nondiagnostic, a CT scan may be performed, but risks of radiation exposure should be explained to the parents. MRI avoids radiation exposure but is costlier and not always available.

What are the outcomes of NOM vs. surgery?

Preliminary studies support the safety of NOM for children with uncomplicated appendicitis, and growing evidence shows health care costs are lower while patient and family satisfaction are high.

Eleven pediatric hospitals in the Midwest Pediatric Surgical Consortium are looking at treatment outcomes for NOM of uncomplicated appendicitis compared to surgery in a prospective cohort study of children ages 7-17 years. Patients with nonperforated appendicitis enrolled between April 2015 and April 2017 will choose NOM or appendectomy.

Data collection includes clinical information and quality-of-life measures as well as long-term follow-up by phone to gather details about post-treatment morbidity, recurrent appendicitis, disability days and health care satisfaction.

According to preliminary data from a single institution's ongoing study (Minneeci PC, et al. *JAMA Surg.* 2016;151:408-415), NOM had a success rate of 89.2% at 30 days and 75.7% at one year. The incidence of complicated appendicitis was 2.7% in the NOM group and 12.3% in the surgical group. After one year, children treated with NOM had fewer disability days compared to the surgery group (eight vs. 21, respectively; $P < .001$) and lower appendicitis-related health care costs (\$4,219 vs. \$5,029; $P = .01$).

A pilot randomized, controlled trial compared NOM and appendectomy for acute, nonperforated appendicitis (Svensson JF, et al. *Ann Surg.* 2015;261:67-71). Of 50 enrolled patients, 22/24 (92%) treated by NOM had initial resolution of symptoms. Two of the 24 had appendectomy within the time of primary antibiotic treatment, and one (5%) underwent appendectomy for recurrent appendicitis after nine months. Another six had appendectomy for recurrent abdominal pain (n=5) or per parental wish (n=1) during the follow-up period, but none had appendicitis on histopathology.

In summary, appendectomy still is the standard of care for appendicitis, but NOM of uncomplicated appendicitis is a realistic option for patients who fulfill the appropriate clinical criteria. Patient selection, setting clear expectations with families and maintaining an open dialogue with parents and the primary care physician regarding the patient's care plan are key elements for successful NOM.

Dr. Loeff and Dr. Taylor are members of the AAP Section on Surgery.