



PEDIATRIC SURGERY *Update**

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Complicated Appendicitis: How much antibiotics?

Appendicitis is the most common acute surgical emergency in children. Though medical management of appendicitis using parenteral antibiotics has gained popularity, laparoscopic or open appendectomy is still the standard of care. The basic tenets of management of appendicitis are resuscitate children with systemic inflammatory response syndrome, control the source of contamination, remove most of the infected or necrotic material and administer antimicrobial agents to eradicate residual pathogens. Appendicitis can be classified as simple or complicated. Complicated appendicitis refers to histologic changes in the appendix associated with either gangrene and/or perforation. Perforated appendicitis occurs in approximately 25-30% of children presenting with acute appendicitis. Traditionally, complicated appendicitis is managed postoperatively with 7-14 days of antibiotics. This long therapeutic regimen has been challenged periodically. The main reasons for postoperative antibiotics after appendectomy in complicated appendicitis is reducing the incidence of surgical site (wound) infection and formation of intraabdominal fluid collections (abscess). Excluding gangrenous appendicitis, wound and intraabdominal infection rates for children with perforated appendicitis are 4% and 8% respectively. With the standard use of laparoscopy with smaller incisions for appendectomy the surgical site infection rate has decreased considerably. All children undergoing appendectomy should receive a preoperative dose of a broad-spectrum antibiotics before surgery. Cases with simple appendicitis or normal appendix do not need to receive postoperative antibiotics as postoperative infectious complications are extremely rare in this group after a single preoperative dose of antibiotics. Complicated appendicitis can be managed with shorter course of three to 5 days of postoperative antibiotics after adequate source control. This course depends on the clinical response of the child. In synthesis, the parameters utilized to evaluate the clinical response to postoperative antibiotic therapy includes temperature, heart rate, WBC count, and gastrointestinal dysfunction due to peritonitis. This means that until fever subsides ($T < 38.5\text{ C}$), normal heart rate returns, $WBC < 11$ and resolution of ileus with oral intake is not achieved, the child will need antimicrobial therapy. The STOP-IT trial found that outcomes in patients with intraabdominal infections who undergo successful source control procedure and received a fixed 4-day course of antimicrobial therapy had similar results in outcome as patient whom systemic antimicrobial agents were administered until after resolution of signs and symptoms of sepsis. The occurrence of a postoperative abscess is the single most important determinant of outcomes in children with perforated appendicitis. Retained fecalith after appendectomy are a source of continued and recurrent infection and should be removed surgically. As we define better

grades of perforation during surgery, we will be able to correlate them with increased postoperative abscess rate.

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Intraoperative Cholangiogram

Cholelithiasis has increased in incidence in the pediatric population, mostly the result of western diet and improve ability to detect them using ultrasonography. Cholelithiasis can cause biliary colicky pain, acute and chronic inflammation, pancreatitis and biliary obstruction from gallstone impaction in the common bile duct (choledocholithiasis). Hemolytic disorders account for 20% of children with cholelithiasis. Laparoscopic cholecystectomy (LC) is the gold standard method for gallbladder removal in children and adults with disease gallbladder. In children with gallstone pancreatitis, biochemical jaundice, cholangitis or ultrasound evidence of bile duct dilatation an MRCP should be performed to diagnosed choledocholithiasis before embarking in removal of the gallbladder. Laparoscopic removal of the gallbladder with bile duct obstruction could result in leakage of the cystic duct stump or development of cholangitis. In the laparoscopic era, ERCP with sphincterotomy is used either before LC for suspected common bile duct (CBD) stones or after LC for missed CBD stones, bile duct injuries or late strictures. Intraoperative cholangiogram (IOC) is a technique in which a small catheter is passed either through the cystic duct or infundibulum of the gallbladder, contrast is injected, and fluoroscopic films of the biliary tree are obtained. IOC was first reported in the early 1990's. Previous indications for IOC include findings of bile duct dilatation, defining aberrant biliary tree anatomy, in cases of confused anatomy, confounding biliary disorders (choledochal cysts, biliary atresia or other congenital anomalies), and when bile duct injury is suspected during cholecystectomy. In places where MRCP is not available, IOC is useful to identify biliary anomalies or obstruction causing choledocholithiasis, cholangitis, elevated liver enzymes or pancreatitis. With time, IOC has gone from a routine procedure to a selective procedure during removal of the gallbladder in children. IOC adds time to the procedure potentially increasing costs, puts the patient at risk of iatrogenic injury, adds radiation exposure to the patient, and is no more sensitive than preoperative MRCP. Recent nationwide database

studies of cholecystectomies in children have found that: 1) Routine IOC is more commonly employed in children with cholecystitis and less commonly performed in patients with cholelithiasis. 2) Cholecystectomy alone when compared against cholecystectomy with routine IOC is associated with higher rates of bile duct injury, perforation, laceration, sepsis and other infections. 3) These children are less likely to have readmission to the hospital within 30 days and one year. 4) Patients who undergo routine IOC have decreased hospital length of stay and decreased overall index hospital costs. Other studies have found IOC and hospital operative volume are not readily associated with decreased bile duct injury. Increase use of IOC or tendency is associated with increased risk for bile duct injury. The use of IOC is associated with surgeons' preference and training as there is no clear evidence to guide routine utilization.

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Appendicitis during Covid19 Pandemic

Acute appendicitis is the most common surgical emergency in children. More than 70,000 appendectomies are performed in children each year in the USA, approximately one-third of childhood admissions for abdominal pain. Since the discovery of Sars-Cov2 coronavirus as the cause of Covid19 disease early in 2020, a global pandemic developed which continues to affect medical and surgical care of children and adults. Children who develop Covid19 mostly suffer from a mild disease process, only a minority presenting with respiratory distress syndrome or multiorgan failure. With the pandemic the instructions to the population were to stay home, avoid visiting local clinics and hospitals while using more telemedicine-based practice. In many institutions programmed or elective surgery was postponed. Parental concerned with the possibility of contracting Covid19 in public places such as clinics or emergency rooms couple with inadequate clinical evaluation using telemedicine, and the inability to perform a full physical examination led to a delayed diagnosis of appendicitis. This resulted in an increase in development of complex appendicitis (gangrenous and perforated) along with an increase in intraabdominal

complications such as perforation and peritonitis with peri-appendicular abscess formation. An increased reliance on outpatient care during a time when many clinics were not seeing patients most likely contributed to delay in diagnosis. As hospital systems were reaching capacity, a delay in presentation was created due to the need for transfer from one health care center to another. A few institutions changed to non-operative management of appendicitis in an effort to conserve resources, minimized non-emergent surgical procedures and allow for Covid19 testing to result. Non-operative management with intravenous antibiotics can be applied to almost 50% of children presenting with acute appendicitis. Children with persistent pain, leukocytosis or an appendicolith in images were taken directly to the operating room for laparoscopic appendectomy. The observed increase in complicated appendicitis cases in children during 2020 is most likely due to Covid19 pandemic. In other institutions the covid19 pandemic increased the number of children managed for acute appendicitis during the lock down due to closure of general surgery departments in proximity hospital resulting in an increase in referral to children hospitals. Children managed for acute appendicitis were older than historic controls and more commonly transferred from other institutions. Nonoperative management of uncomplicated appendicitis in children resulted in an increase in length of stay and readmission. Age at presentation correlated with increased severity of disease on presentation and higher rates of perforation and intraabdominal abscess formation, increased use of antibiotics, longer length of stay and longer duration until symptoms resolution for children managed during the pandemic. Children with appendicitis presented during the pandemic with more advanced disease.

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