9. Pediatric colonoscopy

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Synopsis

Since its introduction almost forty years ago, colonoscopy has become a routine procedure, not only for adults, but pediatric patients with rectal bleeding, chronic diarrhea, change in stool caliber, and chronic lower abdominal pain. It is safely used in all groups of children, including newborns.

Although the instruments are similar, pediatric colonoscopy is different from colonoscopy in adults, in many aspects such as preparation, sedation, technique, and spectrum of therapeutic manipulations.

Indications for colonoscopy

Indications for diagnostic and therapeutic colonoscopy are listed in Fig. 1. Although colon cancer is not one of the usual indications for colonoscopy in children, colonoscopy and biopsy are performed for surveillance for detection of malignancy in patients with long-standing inflammatory bowel disease.

Patients who have undergone small intestinal transplantation may need to undergo ileoscopy and/or colonoscopy to obtain specimens from transplanted bowel to look for rejection and evidence of lymphoproliferative disease.

When diagnostic colonoscopy is not indicated

Colonoscopy is not indicated in patients with:

- acute self-limited diarrhea;
- gastrointestinal bleeding with a demonstrated upper gastrointestinal source;
- stable recognized irritable bowel syndrome;
- chronic-nonspecific abdominal pain;
- constipation with or without impaction;
- inflammatory bowel disease that is responding to treatment.

Diagnostic colonoscopy is absolutely contraindicated (Fig. 2) in anyone with fulminant colitis, toxic megacolon, or suspected perforated viscus. Recent intestinal resection represents a possible contraindication to the examination. However patients with acute severe colitis in which cultures are negative for bacterial pathogens and parasites, such as E. histolytica and Trichurus trichura, should have an examination of the rectum and distal sigmoid colon to help establish whether they have a specific type of colitis. In such cases, limiting the area viewed as indicated does not pose an undue risk. There are times when direct visualization of the mucosa gives a specific diagnosis such as when pseudomembranes are seen or punched out ulcers can be visualized.

Physicians should not consider doing colonoscopy in patients who have chronic or recurrent abdominal pain without other signs and symptoms, such as weight loss, failure to grow, loss of appetite, perianal disease, and positive indicators for inflammatory bowel disease, such as an elevated sedimentation rate, increased C reactive protein, and positive screening panel for inflammatory bowel disease.
Preparation of the patient for colonoscopy

**Explanation**

The risks and benefits of colonoscopy are reviewed with the family usually at the time that the procedure is scheduled. At that time questions and answers about the procedure may be discussed.

Preparing infants and children for colonoscopy can be difficult. Children who are less than school age may not understand why they are asked to have a restrictive diet and a simple explanation of why the test is being done is all that should be provided. The physician should try to use words that the child will understand in order to clarify why they are going to be tested. The physician and parents need to simply tell the child they are going to have a test to look at where their ‘poop’ comes from and it has to be clean inside to take a good look.

In school-age children and in adolescents fuller explanations may be provided depending on the level of sophistication of the child. It is useful to show the children and parents diagrams of the rectum and colon and distal small bowel to make them aware of what is going to be examined. Providing such knowledge ahead of time may make the child or adolescent more amenable to the procedure and more cooperative in preparing for the examination. It may be helpful to show pictures of the instruments used and simple diagrams of what may be normally seen.

Children at any age should be told that they will be given an intravenous infusion through which they will receive medications to make them sleep and to minimize any pain or discomfort.

Because most colonoscopists use medication to alter memory such as Valium or Versed the child should be told they will have little memory of their procedure other than going to sleep and that they will have little or no pain during the procedure.

Most children will be reassured by having the information that they will have devices attached to their fingers and arms, which measure their blood pressure or how hard their heart pumps, how fast their heart is beating, and the rate or speed at which they are breathing. Older individuals can be told that devices will be used to tell how much oxygen is in their blood. Apprehension will be diminished by informing children of all ages that when they awake from their sleep their parent or parents will be nearby.

Most children, but not all, will accept the preprocedure explanation well and this will serve to alleviate much of their anxiety.

**Antibiotic prophylaxis**

Prophylactic antibiotics are administered to children following the national guidelines.

**Bowel preparation**

The most difficult preprocedure activity is to prepare the bowel so it can be adequately visualized. A number of different regimes are available that are based either on wash out of the bowel (lavage) or cathartics. Both methods are subject to failure because they usually rely upon the cooperation of the infant or child and even best efforts of the medical staff may be frustrated in getting the infant or child adequately cleaned out.
**Purge methods**

In infants, the best technique usually involves clear liquids and milk of magnesia. Milk of magnesia 1.0 mL/kg of body weight is given two nights before the procedure and mid-day the day before the procedure.

Magnesium citrate may also be used in children above one year of age. This may be divided in two doses and given 24 and 12 hours before the colonoscopy. It is best given cold and over ice, or mixed with lemon-lime type soft drinks. Some individuals become nauseated with this and other cathartics. It is often better accepted if the dose of magnesium citrate is divided in four fractions taken over a four-hour period of time.

The night before the colonoscopy, we often prescribe a glycerin suppository to enhance evacuation.

The above preparation regimen is probably the most benign of the various methods available and is the one with which the infant or child is most likely to cooperate.

**Lavage methods**

In the lavage methods the patient is allowed to eat and drink up until the afternoon before the procedure. The patient then fasts for four hours. We prefer a flavored lavage solution which contains a nonabsorbable agent such as sorbitol or mannitol. 5–10 mL/kg up to 250 mL is given by mouth every 10 minutes, and is continued until the rectal effluent is clear.

A large volume-balanced electrolyte lavage solution may also be administered. The dosage may be split so that half is given the day prior to the examination, and the rest on the day of the procedure. Some adolescents and teenagers will accomplish taking this solution readily. In the younger age child, however, success is less assured. Hospitalization for 24–48 h may be necessary before the procedure to cleanse the colon in uncooperative patients, where the placement of a nasogastric tube into the stomach may be the only way to guarantee administration of the solution. A randomized study of 2 doses of sodium phosphate vs. a large (4 L) polyethylene-glycol preparation was performed in pediatric patients. Compliance was easy or tolerable in 80% of the phospho-soda group but in only 33% of those who took the electrolyte prep. The bowel was well prepared in almost all of the former, but in only 40% of the group who were given the large volume prep. Asymptomatic hyperphosphatemia was noted in the patients who took sodium phosphate.

If the child vomits in response to the lavage, the rate of infusion may have to be curtailed. Continuous nasogastric tube infusion of the large volume electrolyte solution over a period of 12 hours is very effective if children vomit the solution when it is given rapidly. During the infusion, metoclopramide 0.1 mg/kg is given to a maximum of 10 mg 20 minutes prior to lavage and every four hours to enhance gastric emptying.

Overdistention of the stomach or slow gastric emptying should be suspected if stool is not passed within the first four hours after starting the lavage technique. The rate of infusion of the balanced electrolyte lavage solution is usually between 100 and 200 mL per hour up to a full volume of four litres. We typically give an infusion into a peripheral vein to provide maintenance fluids and electrolytes.
Enema ▲▼

Enemas should not be used if the colonoscopist is looking for evidence of inflammatory bowel disease in the rectum and sigmoid colon since enemas often cause erythema of the colonic mucosa and petechiae, giving a false-positive macroscopic image.

Equipment ▲▼

Pediatric colonoscopes less than 11 mm in outer diameter are commercially available. They have a 3.2-mm biopsy channel, which allows the use of all accessories, such as standard biopsy forceps, snares, needles, and thermal probes. Colonoscopes with adjustable stiffness are more suitable for children over four years of age.

Colonoscopes specifically designed for infants and toddlers do not exist. Instead, pediatric upper GI endoscopes can be used. Although it is more difficult to telescope the sigmoid colon with these instruments, higher flexibility and smaller diameter prevent excessive stretching of the bowel, especially in infants.

Medication ▲▼

The child and one, or both parents or grandparents, may be brought to the pre-endoscopy area, where an intravenous infusion is started. In order to minimize the discomfort of the intravenous needle, Emla cream may be applied to three or four potential intravenous sites 45 min before an angiocath is placed into a peripheral vein.

Full and continuous monitoring is necessary during the procedure. Sedation is begun after baseline vital signs are obtained.

Sedation ▲▼

The most commonly used sedation for colonoscopy includes use of tranquilizers for relief of anxiety and narcotics for sedation-analgesia.

The narcotic of choice is Fentanyl, which is rapid acting with a short half-life and minimal side-effects. It rarely causes nausea and vomiting and does not lower the seizure threshold. Doses typically are 4 µg/kg given in 1 µg/kg boluses every 2–3 min. This regime is continued until a state of sleepiness is reached or the patient, when asked to count to 10 cannot complete it.

Midazolam (Versed) is the most commonly used tranquilizer in children because of its speed of action and effectiveness. Doses range from 0.15 to 0.30 mg/kg given in divided doses. Midazolam is administered and each dose is flushed in with normal saline.

A two-minute time interval subsequent to each dose of medication is allowed before the patient is either questioned or (if old enough) asked to count from 1 to 10 and then backwards from 10 to 1.

If after giving a total dose of 4 µg/kg of fentanyl and 0.3 mg/kg of midazolam the patient is still awake, not sleepy and can count coherently, promethazine may be given. The dosage used is 1 mg/kg up to 25 mg. Additional sedation with midazolam or fentanyl may be needed during the procedure.
**Anesthesia**

Anesthesia may be necessary if routine sedation is not successful. Agents such as ketamine and propofol may be necessary but they are best and most safely administered by an anesthesiologist. Many pediatric gastroenterologists do not use sedation-analgesia, and perform all cases under propofol anesthesia given by the anesthetist.

**Technique of colonoscopy**

Following sedation the patient is placed in the left lateral decubitus position. The parents are asked to leave the room once the patient is sedated. We do not make it a practice to allow parents to stay for the procedure.

Complete colonoscopy can be performed successfully in the majority of children. Many factors can influence and complicate the procedure, e.g. redundant large intestine, improper preparation, previous surgeries, etc. It is important to understand the general principles of pediatric colonoscopy.

**Guidelines**

Guidelines for safe and effective colonoscopy are:

- The intubated colon adopts configuration and shape according to manipulations and movements with the colonoscope, and the pattern of these changes are predictable, as well as the direction in which the colonoscope tip should be moved.
- Rotation, twisting, withdrawal, and simultaneous to and fro movements of the shaft will prevent formation of big ‘loops’, mesenteric stretching, and related abdominal pain and discomfort.
- Excessive insufflation leads to overdistention and diminishes ability to telescope the bowel.
- During the procedure, the patient's comfort is provided by appropriate anesthesia, as well as optimal technique of colonoscopy. Excessive pushing forward creates more problems than benefits for the endoscopist.

The principles of pediatric colonoscopy are similar to those in adults, but because of the child's small stature, angulations may be more acute. In the child, it is often possible to palpate a loop of the scope in the abdomen, a clue that instrument withdrawal and straightening are needed. Meticulous attention to technique is required in children because the colon wall is thin, and, in the presence of anesthesia using propofol, there may not be any noticeable feedback from the patient that would provide a clue as to pain or discomfort from an overstretched mesentery or overdistended bowel (Fig. 3).

The key to effective colonoscopy is to minimize pain and discomfort. It is critical to try and keep the lumen of the bowel in sight knowing where the tip of the colonoscope is and trying to keep the colonoscope straight with avoidance of loops.

The mucosal pattern of the colon is best evaluated as the instrument is slowly withdrawn. However, we think it is important to carefully look at the mucosa while advancing forward, since trauma can sometimes occur to the mucosa with the passage of the instrument, and if abnormalities are not identified beforehand, one is always left wondering whether what one sees is due to colonoscopy, vs. the underlying pathology.
Risks and complications of colonoscopy ▲▼

The potential risks and complications of colonoscopy include bleeding, perforation, infection, and difficulties with sedation (such as paradoxical reaction to the agent used). A higher dose of analgesic medication may be required for colonoscopy, vs. upper intestinal endoscopy, because procedures involving the colon may produce more intensive pain and/or require longer procedure time. The higher doses of medication require careful monitoring because there may be a limited margin between inadequate sedation and oversedation.

Bowel perforation and hemorrhage related to pediatric colonoscopy are serious but rare complications of colonoscopy. During diagnostic colonoscopy the estimated frequency of colonic perforation, most commonly in the sigmoid, is in the range of 0.2–0.8%. This is an extremely low risk of perforation. The frequency is higher with therapeutic colonoscopy procedures such as polypectomy but is still comparatively rare ranging from 0.5 to 3%. Mortality is extremely low and should be substantially less than 0.2%.

Indications for colonoscopy ▲▼

Rectal bleeding in children ▲▼

Careful history and physical examination may suggest the correct diagnosis such as recent exposure to antibiotics (antibiotic associated colitis), perianal streptococcal cellulitis, or an anal fissure. Allergy to cow's milk or soy protein may cause rectal bleeding in the absence of any other symptoms. Every child with hematochezia does not require colonoscopy. Perianal fistulas, skin tags, and hemorrhoids are indicative of Crohn's disease in children less than 18. Fissures are caused by passage of large bulky stools, with bright red blood on the outside of stool or mixed with the fecal stream if unformed.

Stool studies on every patient who has rectal bleeding should include a smear for polymorphonuclear leukocytes. Bacterial culture is indicated if leukocytes are present (Shigella, Salmonella, Campylobacter, E. coli, and Yersinia enterocolitica). If antibiotics have been taken in the past three months, Clostridium difficile toxin titres (A and B) should be requested. The parasitology lab should look for Entamoeba histolytica and Trichurus trichura. The presence of eosinophils and Charcot–Leyden granules indicates allergic colitis.

In the pediatric patient with persistent or recurrent hematochezia and no identifiable cause, colonoscopy or flexible sigmoidoscopy is the procedure of choice to search for mucosal changes or other lesions associated with bleeding. Twenty-five percent of patients at colonoscopy who have colitis will have unclassified microscopic changes. Nodular lymphoid hyperplasia of the colon typically seen in early infancy is characterized by umbilicated lesions in the rectum, sigmoid, and/or colon.

Pain accompanying rectal bleeding may be caused by anal fissures, but intermittent cramping pain and the passage of ‘currant jelly-like’ stool should raise the suspicion of intussusception, although dark or red blood may be seen. Vasculitis of the Henoch–Schonlein type typically presents with skin lesions, but the patient may have only abdominal pain and rectal bleeding. Endoscopic biopsy may be diagnostic when taken from areas of bleeding or from ulcerations.

Chronic diarrhea ▲▼

Nonbloody diarrhea is an uncommon indication for colonoscopy unless it is chronic and the stool
cultures and ova/parasites have been nondiagnostic. Approximately 5% of patients who have colitis will not have polymorphonuclear leukocytes present in their stool. Microscopic colitis has been described in children presenting with chronic diarrhea, abdominal pain, loss of appetite, and weight loss. Multiple biopsies should be taken from the small bowel and colon in the patient with chronic diarrhea even if no abnormality is visible to gross visual inspection.

**Inflammatory bowel disease, colitis, and cancer**

*Clostridium difficile* may show characteristic pseudomembranes, however, this is not pathognomonic for this bacteria and it may also be seen following Shigellosis. Allergic colitis that is more typically seen in young infants may be nonspecific. Polyps, foreign bodies, and internal trauma from abuse may all be identified at colonoscopy. Lesions such as angiectasias or rectal varices may also be visualized. Cathartic abuse may also be recognized by the typical tigroid stripes seen in the mucosa.

The importance of colonoscopy in patients with inflammatory bowel disease is to define the extent of the inflammation, to obtain tissue samples that may establish the specific diagnosis, and as an aid in planning therapy.

Development of adenocarcinoma of the colon in children is extremely rare but does occur even in children who never had ulcerative colitis. It typically presents with intermittent rectal bleeding and no diarrhea or with a progressive change in stool caliber.

The determining factor in the development of cancer in ulcerative colitis seems to be related to three factors: the severity of the original attack, the extent of mucosal involvement, and the duration of colitis. The cancer risk for patients with universal colitis involving the entire colon is not dependent on the age of onset, so children are at risk who have the disease for about 8 years, and even young persons with universal colitis should begin surveillance colonoscopy after 8 years of disease. Children of patients with inherited polyposis syndromes should have a surveillance colonoscopy to identify the presence of polyps and this is recommended to begin at 11 years of age.

**Therapeutic colonoscopy**

Juvenile or inflammatory polyps are not uncommon in children. They are most common in the 4–6 years age group but may be present as early as age 1 year. They are uncommon after age 18. Although autoamputation may occur in these cases many will not spontaneously disappear. This is the reason why when patients present with rectal bleeding and polyps are suspected, colonoscopy is indicated to remove the polyp with snare and cautery. The bleeding is usually painless, but the only symptoms may be anaemia from more proximal polyps although most polyps are in the left colon.

Hereditary polyposis syndromes are often confirmed by following the patient colonoscopically and by doing polypectomy.

**Summary**

Colonoscopy in children is different from colonoscopy in adults. The preparation must be more carefully explained to the parents or guardians, and compliance can often be a problem. The equipment is the same as used in adults, but a gastroscope can be quite useful for negotiating acute angulations. The technique of the examination is similar, but the bowel wall is quite thin and may not withstand the formation of large loops. The pathology in children as well as indications for colonoscopy are also
different from that found in adults with rectal bleeding being the commonest indication, and neoplastic
disease being the least likely pathology finding. With adequate sedation, careful monitoring, and
meticulous attention to technique, colonoscopy in children can be a safe and rewarding procedure.

**Suggested reading**


glycol-based solution for bowel preparation for colonoscopy in children. *J Ped Gastroenterol Nutr* 23,
586–90.


59. [PubMed]


of diagnoses based on simple biopsy criteria differentiating among Crohn's disease, ulcerative colitis,


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