Endoscopy in Special Situations in Inflammatory Bowel Disease

Acute Colitis, Pregnancy, and Pediatrics

Zoe Gottlieb, MD[a], Michelle Gonzalez, MD[b], Sunanda Kane, MD, MSPH[c,*]

KEYWORDS

• Pregnancy • Pediatrics • Endoscopy • Acute severe ulcerative colitis • Sigmoidoscopy • Colonoscopy

KEY POINTS

- Indications for endoscopy in the hospitalized patient with acute severe ulcerative colitis are limited and full colonoscopy discouraged given risk of perforation.
- Lower gastrointestinal endoscopy does not increase the risk of adverse pregnancy outcomes and can potentially reveal clinically relevant findings that impact clinical decision-making.
- Pediatric endoscopy should be performed by proceduralists trained in pediatric gastroenterology.
- For patients with inflammatory bowel disease and primary sclerosing cholangitis screening for colorectal cancer should be every 1 to 2 years after the age of 15 years.

INTRODUCTION

Endoscopy is an important part of gastroenterology care for diagnosis, treatment, and follow-up of inflammatory bowel disease (IBD). There are certain patient demographic groups that require special attention when considering endoscopy. Endoscopy in a pediatric patient comes with more risk as general anesthesia (GA) is required. The pregnant patient also requires more thoughtful planning depending on trimester of gestation. The hospitalized patient with acute severe ulcerative colitis (ASUC) does not need specialized non-gastroenterologist presence but understanding the

[a] Department of Medicine, Mt Sinai Medical Center, 1 Gustave Levy Place, New York, NY 10029, USA; [b] Department of Pediatrics, Mayo Clinic Rochester, 200 First Street SouthWest, Rochester, MN 55905, USA; [c] Department of Medicine, Mayo Clinic Rochester, 200 First Street SouthWest, Rochester, MN 55905, USA
* Corresponding author.
E-mail address: Kane.Sunanda@mayo.edu

Gastrointest Endoscopy Clin N Am 35 (2025) 41–58
https://doi.org/10.1016/j.giec.2024.04.006
giendo.theclinics.com

indications for the procedure to minimize risk is important. We will explore these three unique patient scenarios in the following sections.

ACUTE SEVERE ULCERATIVE COLITIS

For hospitalized patients with acute severe ulcerative colitis (UC), limited lower endoscopy (eg, flexible sigmoidoscopy) without a bowel preparation to assess the severity of mucosal disease is adequate. Complete colonoscopy (ie, endoscopic examination to the cecum) is typically avoided in hospitalized patients with severe colitis because of the increased risk of colonic dilation and perforation.[1] However, data from the prebiologic era suggest that full colonoscopy is safe when assessment of the entire colon is necessary.[2,3] The purpose of the endoscopy is multifactorial to obtain biopsies to exclude cytomegalovirus infection, rule out other sources of hematochezia, and help with prognosticating disease course. In a single-center study from Boston, the investigators were able to show that improvement on a second-look sigmoidoscopy within 9 days of the index procedure was associated with a favorable outcome: no patients with improvement went to colectomy versus 46% with persistent or worsening endoscopic activity went to surgery.[4] In another study from the United Kingdom, 235 patients over 5 years were studied and endoscopy severity predicted steroid response with an odds ratio (OR) of 3.1.[5] In a recent study from Yale, Grant and colleagues studied the impact of early (within 72 hours of hospital admission) versus late endoscopy on outcomes.[6] They found that patients in the early sigmoidoscopy group were exposed to significantly fewer days of intravenous steroids, cesarean section (CS; 4.5 vs 9.2 days; $P < .001$), had shorter hospital stays (6.4 vs 19.3 days; $P<.001$), and shorter time to rescue therapy (3.5 vs 6.4 days; $P = .004$) and a longer time to sigmoidoscopy was associated with a 16% increased risk of colectomy (hazard ratio [HR] = 1.16, $P = .002$).

THE PREGNANT PATIENT

General Considerations

While endoscopic procedures are considered low risk in nonpregnant patients, additional caution must be taken during pregnancy due to both fetal safety concerns and lack of extensive data in this area. Endoscopy during pregnancy should be reserved for patients with strong indications; in IBD, these are patients in whom endoscopic evaluation would affect management[7] (eg, new diagnosis of IBD, significant disease progression requiring a therapeutic change, or decision to go to surgery). Moreover, an understanding of *contraindications* to endoscopy during pregnancy is also essential. These include placental abruption, imminent delivery, ruptured membranes, and uncontrolled eclampsia.[8] Importantly, point-of-care intestinal ultrasound (IUS) is increasingly being used for disease activity assessment and monitoring in IBD, as it can be performed in real time and without preparation with accuracy comparable to that of both magnetic resonance enterography (MRE) and colonoscopy.[9] IUS has been shown to correlate well with both clinical disease activity and fecal calprotectin (FC) levels during pregnancy [10,11] and can be used to assess disease activity into the third trimester (of note, during later stages of pregnancy, visualization of the terminal ileum and sigmoid become increasingly challenging). While IUS cannot provide a precise diagnosis of IBD (and thus does not obviate the need for endoscopic assessment in this setting), it is an excellent tool for assessing disease activity and response to therapy in patients with known disease.[12] As such, IUS can often be used in place of endoscopy during pregnancy, unless histologic data are essential to determining next steps in management.

If endoscopy is deemed necessary for a pregnant patient with IBD, she should be medically optimized beforehand and carefully monitored throughout the procedure, particularly if sedation is used. Procedural planning should be done in partnership with her obstetrician (OB), often with the input of a high-risk OB (maternal–fetal medicine doctor [MFM]). These providers can advise on procedural risks, sedation options, and any special considerations specific to the patient. MFMs can also perform fetal monitoring, the extent of which depends on the gestational age (GA) of the fetus: (1) if less than 24 weeks GA (previable), the American Society for Gastrointestinal Endoscopy (ASGE) and the American College of obstetricians and gynecologists state that fetal heart rate monitoring by Doppler before and after the procedure is sufficient and (2) if greater than 24 weeks GA, both organizations recommend monitoring of both fetal heart rate and maternal uterine contractions before and after the procedure at minimum, but ideally during the procedure as well. [8,13] Importantly, if the fetus is viable, the patient should be informed of the potential need for CS in case of an emergency.[7] Ensuring that each of these needs is addressed is essential to performing the procedure as safely as possible.

Preparation

Multiple types of bowel preparations with varying osmolarities are utilized in the general population prior to colonoscopy. Polyethylene glycol lavage (PEG) solutions are iso-osmolar and thus less likely to precipitate fluid shifts than hyperosmolar formulations. Because normal pregnancy is associated with reduced systemic vascular resistance, pregnant women are at an increased risk of hypotension in the setting of fluid shifts.[14] As such, it can be inferred that any solution that might result in electrolyte and thus volume shifts[15] should be avoided in pregnant women, and therefore, PEG solutions are most preferable. PEG solutions are considered pregnancy category C drugs per the former US Food and Drug Administration categorization system.[16]

Several studies have demonstrated the efficacy of PEG solutions in the treatment of constipation during pregnancy with no clear adverse effects on the fetus.[13,17] However, these were performed using constipation dosing of PEG formulations, rather than the much larger quantity needed for bowel preparation. To date, no studies have explicitly compared the safety and efficacy of different bowel preparations during pregnancy. However, one study examining outcomes in pregnant women undergoing flexible sigmoidoscopy and endoscopy included a small group of patients who received bowel preparation. This case–control study by de Lima and colleagues [18] reviewed outcomes in all pregnant patients with IBD who underwent lower gastrointestinal (GI) endoscopy (LGE; ie, colonoscopy or sigmoidoscopy) between 2008 and 2015 and followed them bimonthly until delivery. There were no adverse outcomes thought to be temporally related to PEG use.[18]

Based on these limited data as well as an understanding of the mechanism and physiologic implications of osmotic laxatives, the use of PEG preparations should be considered safe during pregnancy. However, preparation can be avoided entirely in most cases, as flexible sigmoidoscopy is often sufficient for determining inflammatory disease activity.

Sedation

Whether or not to use sedation during endoscopy is dependent upon the procedure itself as well as patient preference. Flexible sigmoidoscopy is often performed unsedated, as the examination is short and requires less manipulation of the endoscope than a colonoscopy. A colonoscopy, however, is less well tolerated without sedation.

Should colonoscopy be indicated, procedural timing and sedation method should be determined in consultation with both an MFM and an anesthesiologist.[7]

The ASGE recommends using the lowest effective dose of sedation during endoscopy in pregnant patients.[8] Importantly, there have been no data demonstrating that any anesthetic medication is teratogenic at any GA in humans, nor is there evidence that exposure to anesthetics or sedatives in utero has an effect on fetal brain development in humans.[13] The greater risk of many of these medications is to the patient herself, as most have the potential to cause respiratory depression with resultant complications for both mother and baby if administered incorrectly.[19] Additionally, sedation in pregnant patients is associated with an increased risk of aspiration due to both progesterone-induced lower esophageal sphincter relaxation and displacement of the stomach by the growing uterus beginning at around 18 to 20 weeks' gestation.[20] These are important considerations, as intubation in pregnant patients may be more challenging due to both airway edema and weight gain.[20] Moreover, the greatest risk to the fetus occurs in the setting of maternal hypoxemia or hemodynamic instability, either of which may result in impaired placental perfusion and thus oxygen delivery to the fetus.[20] For these reasons, sedation in a pregnant patient must be performed in a controlled setting with careful monitoring of vital signs and oxygenation, appropriate patient placement in the left lateral tilt or decubitus position in the later stages of pregnancy to avoid compression of the inferior vena cava and aorta, and expert management by an anesthesiologist in close communication with an MFM.[7,19]

The pharmacology of analgesic medications may be altered due to multiple physiologic changes that occur during a normal pregnancy. These include changes in bioavailability due to differences in liver enzyme activity, reductions in peak and steady-state drug concentrations due to increased plasma volume, and increased drug clearance due to high cardiac output and high rates of renal excretion.[20] Placental transfer of medications depends on several different drug characteristics, changes in maternal and/or fetal acid/base status, and placental enzymes that may affect drug metabolism. Notably, both drug half-life and duration of drug activity are prolonged in the fetus due to lower rates of both renal excretion and hepatic metabolism.[20] A review of medications typically used for sedation during endoscopic procedures can be found in **Table 1**.

The safety of sedation during LGE has been examined in only 2 studies. The first, published in 1996, examined outcomes in 54 women who underwent a total of 56 LGEs during pregnancy compared to pregnant controls. Of these patients, 7 received sedation (4 with midazolam and 3 with meperidine). There were no adverse outcomes temporally related to LGE (and by proxy, sedation, though this is not explicitly stated).[21] The second study was a retrospective study published in 2020 documenting outcomes in 48 women with IBD who underwent 47 flexible sigmoidoscopies and 3 colonoscopies during pregnancy between 2008 and 2019. Anesthesia (meperidine, midazolam, fentanyl, propofol, or combination) was used in 5 of the 50 procedures; only one procedure required intubation. There were no hospitalizations or adverse events temporally associated with flexible sigmoidoscopy. The authors do not explicitly describe outcomes related to anesthesia, however, given that no adverse events were observed, it can be inferred that no sedation-related complications occurred either.[22]

Procedure

The ASGE last published their guidelines for endoscopy in pregnant and lactating in 2012.[8] These guidelines describe medication safety and appropriate indications for endoscopy during pregnancy and while breastfeeding. Like many publications describing invasive procedures during pregnancy, the authors identify the second

Table 1
Medications used for sedation

Propofol Category B	Benzodiazepines Category D	Opiates Category C	Ketamine Category B
Minimal available data on pharmacokinetics during pregnancy; possible inverse relationship between maternal propofol concentration and serum albumin (↑volume of distribution → ↓serum albumin → ↑free propofol concentration)[20]	Historically avoided as older studies showed increased risk of cleft palate and cardiac abnormalities with diazepam use early in pregnancy; more recent studies have not found association between teratogenicity and benzodiazepine exposure in first trimester[56]	ASGE recommends meperidine over morphine and fentanyl during pregnancy[8]	Can be used in patients who are not sufficiently sedated with propofol[7]
Narrow therapeutic window[8,20]	Adverse outcomes seen with diazepam not observed with midazolam, but this is often avoided due to similar mechanism of action[19]	Some providers opt to use fentanyl due to rapid onset/offset of action[19]	Rapid onset of action, duration of effect is short[7]
Crosses placenta and can cause transient fetal sedation[21]	Lipid soluble with greatest extent of placental transfer later in pregnancy[56]	Meperidine and fentanyl both cross placenta, but meperidine's active metabolite has a longer half half-life → more sustained medication effects[57]	Crosses the placenta very quickly (<2 min after IV administration)[56]
Minimal safety data for use in first trimester[8,20]	Third trimester exposure can be associated with adverse fetal outcomes[56]	Neither fentanyl nor meperidine are teratogenic, but both can →transient, reversible reductions in fetal heart rate variability (not associated with fetal hypoxia)[17]	Higher doses in the first trimester can cause hypertonicity of the uterus and decreased uteroplacental blood flow→ hypoxia; exposure in the third trimester can cause neurotoxicity[56]
Generally considered safe; greatest risk is maternal hypotension[56]	Likely safe; avoid as delivery approaches	Generally considered safe in pregnancy; avoid high doses over prolonged periods, particularly at term[17]	Later in pregnancy, increased uterine tone can →premature contractions/labor[23]
			Data limited; lower doses may be safe but higher doses/prolonged administration should be avoided[19]; avoid in later pregnancy as can lead to premature labor[23]

Abbreviation: ASGE, the American Society for Gastrointestinal Endoscopy.

trimester as the optimal time for endoscopy. This is presumably because it allows for avoidance of procedure-related stressors and medication exposures during organogenesis and placentation during the first trimester and reduces the risk of procedure-associated premature labor, which can occur in the third trimester in the setting of increased uterine irritability.[23] Moreover, most data for endoscopic outcomes in pregnant women are from the second trimester.[19] Of note, contrary to this recommendation, a nationwide cohort study by Ludvigsson and colleagues from 2017 did not find a significant difference in the risk of adverse pregnancy outcomes following endoscopy based on trimester, nor did a systematic review by de Lima and colleagues published in 2015.[24,25]

Safety of the endoscopy itself has been explored in several studies and multiple case reports (**Table 2**). The aforementioned systemic review by de Lima and colleagues published in 2015 examined the results from 1 retrospective uncontrolled study, 2 retrospective case–control studies, and 79 case reports exploring outcomes in women who underwent LGE during pregnancy.[25] All 3 retrospective studies were performed by the same lead investigator. The uncontrolled study, published in 1995, was a retrospective review of 24 patients who underwent a total of 26 flexible sigmoidoscopies over a 7 year period. No adverse events associated with the procedures were observed (while there was one fetal demise, this occurred in a patient with multiple comorbidities 9 weeks after sigmoidoscopy), and helpful clinical data were obtained in most cases.[25,26] The first case–control study, published in 1996 and briefly described in the *Sedation* section, found no significant difference in birth outcomes between groups, and rates of adverse outcomes in both groups were similar to national rates during that time period. Four high-risk pregnancies ended in fetal demise (all 2 months or more after LGE); however, none of these outcomes was considered related to LGE. In this study as well, most LGEs yielded clinically significant findings.[21,25] The final retrospective case–control study, performed in 2010, compared adverse fetal outcomes in 20 pregnant women who underwent colonoscopy to 20 matched controls who did not undergo colonoscopy but had the same indication for endoscopic evaluation. Colonoscopy allowed for a diagnosis of IBD, microscopic colitis, or ischemic colitis in over 50% of patients and resulted in a change in therapy in 35% of patients. Rates of unfavorable outcomes were similar or lower in the endoscopy group compared to controls, but higher in both groups compared to the general population. The authors attributed these findings to the underlying disease process (ie, active IBD) rather than LGE, as they were found no difference between control and intervention groups.[25,27]

Along with these 3 studies, the authors reviewed the results from 79 case studies of women who underwent LGE during any trimester of pregnancy.[17] Across all studies, the authors found a 6% to 7% rate of adverse fetal outcomes following endoscopy that seemed attributable to the procedure itself. Events occurred during all 3 trimesters. Based on these data as well as the 3 previously described retrospective studies, this review concluded that LGE is likely low risk during pregnancy and should be performed for strong indications, particularly if the procedure will affect management.

In addition to the aforementioned review, de Lima and colleagues published a prospective case–control study in 2015 exploring outcomes in women with active IBD who underwent LGE versus matched controls who were not scoped. All patients had active disease based on clinical parameters and biochemical markers (C-reactive protein, FC elevations); those who underwent LGE had failed to self-resolve and did not respond to a week of treatment with mesalamine or budesonide. Patients underwent LGE in any trimester. The authors found that 76% of patients in the case group had active disease on endoscopy; of these, 75% had a change in or modification of therapy

Table 2
Summary of studies exploring risk of endoscopy during pregnancy

Author/Year	Study Design/Sample Size	Design/Outcomes	Conclusion
De Lima et al,[25] 2015	Systematic review of one retrospective uncontrolled study (1995, *n* = 24), two retrospective case–control studies (1996, *n* = 54, 2010, *n* = 20) and 79 case reports	1995: 24 pregnant patients who underwent 26 flexible sigmoidoscopies • No adverse events associated with endoscopy • Most scopes provided helpful clinical data 1996: 54 pregnant patients who underwent 56 LGEs vs controls • No significant difference in birth outcomes between groups • Rates of adverse outcomes in both groups similar to national rates at that time • Most scopes provided helpful clinical data 2010: 20 pregnant patients who underwent 20 colonoscopies vs 20 matched controls who were not scoped • No significant difference in rates of adverse outcomes between groups, though rates in both groups higher than those in general population (thought to be due to underlying disease process) • Most scopes provided helpful clinical data Case reports: results from 79 studies of women who underwent LGE at any time during pregnancy • 6%–7% rate of adverse fetal outcomes post-endoscopy, occurred in all 3 trimesters	LGE is likely low risk during pregnancy and often provides clinically meaningful data that impact care decisions LGE should be performed if there is a strong indication, especially if result will change management

(*continued on next page*)

Table 2
(*continued*)

Author/Year	Study Design/Sample Size	Design/Outcomes	Conclusion
De Lima et al, *JCC* 2015	Prospective case–control study (n = 42)	42 pregnant women who underwent 47 LGEs across all trimesters vs 42 matched controls. All patients had active disease; patients who underwent LGE had not improved after a week of mesalamine or budesonide treatment. • No adverse maternal events directly related to LGE; overall proportion of adverse fetal outcomes not significantly different between cases and controls • 76% of patients had active disease on LGE; of these, 75% had therapy modification based on results	LGE confers a low risk of adverse maternal or fetal outcomes during any trimester and yields clinically meaningful data in majority of cases
Ludvigsson et al,[24] 2017	Nationwide cohort study (*n* = 3052)	3052 pregnant women who underwent endoscopy vs 1.6 million controls over 19 year period; deliberately included women with lifetime history of GI disease (reduce likelihood that underlying disease, rather than endoscopy, was cause of adverse pregnancy outcome, though women without history of GI disease also included). Also studied • Women who underwent endoscopy during pregnancy vs women who underwent endoscopy <1 y before pregnancy (reduce bias that women scoped during pregnancy more likely to have more severe disease) • Outcomes in women who had endoscopy in the year before or after pregnancy but not during (assess impact of underlying disease activity on pregnancy outcomes) ◦ Endoscopy group had higher risk of preterm delivery, IOL, need for CS, SGA, and LBW vs controls ◦ Late endoscopy did not trigger childbirth	Adverse events related to endoscopy were relatively rare and unrelated to trimester of pregnancy Adverse outcomes associated with endoscopy more likely due to underlying disease activity than the procedure itself

		○ No increased risk of SGA or congenital malformations associated with endoscopy based on trimester ○ All patients who underwent endoscopy had increased risk of adverse outcomes vs controls, but risk higher in patients with history of GI disease ○ In IBD vs non-IBD who underwent endoscopy, IBD patients had significantly increased risk of preterm labor, IOL, need for CS and LBW; non-IBD patients had only increased risk of needing CS ○ Endoscopy group had higher risk of preterm birth and IOL vs women who had endoscopy 1 year before or after pregnancy, however, increased risk did not persist when scope group was limited to women *without* a history of GI disease ○ Women with endoscopy before/after pregnancy had increased risk of preterm delivery, IOL, need for CS, APGAR < 7, LBW, and major congenital malformations vs women with no history of endoscopy	
Ko et al,[22] 2020	Retrospective cohort study (n = 48)	48 pregnant women underwent 50 LGEs across all trimesters • No hospitalizations or adverse pregnancy outcomes related to LGE during any trimester • 88.4% of patients had active IBD; ~63% had moderate–severe disease activity • LGE → change in therapy in 78% of cases	LGE confers a low risk of adverse maternal or fetal outcomes during any trimester and yields clinically meaningful data in majority of cases

Abbreviations: CS, cesarean section; IOL, induction of labor; LBW, low birth weight; LGE, lower GI endoscopy; SGA, small for gestational age.

based on their results. There were no maternal adverse events directly related to LGE, and the overall proportion of adverse fetal outcomes (low birth weight (LBW), GA at birth, proportion of preterm births, APGAR scores at 1 and 5 minutes, congenital abnormalities) was not significantly different between cases and controls. Additionally, the authors did not find a temporal relationship between LGE and induction of labor (IOL) or preterm birth. While there were two spontaneous abortions temporally related to endoscopy in the first trimester (both in patients with severely active disease on endoscopy), the rate of this outcome was actually higher in the control group (4.8% in cases vs 23.8% in controls). The authors concluded that LGE was of low risk for maternal or fetal adverse outcomes, regardless of trimester.[18]

Another study published by Ko and colleagues in 2020 demonstrated similarly reassuring findings. This retrospective cohort study reviewed outcomes in 48 women who underwent a total of 50 LGEs (47 sigmoidoscopies, 3 colonoscopies) across all trimesters of pregnancy between 2008 and 2019. Eighty-five percent of patients had IBD; in the remaining 15%, an LGE was indicated to rule out IBD in the setting of GI bleeding. There were no hospitalizations or adverse pregnancy events related to endoscopy observed during any trimester. The authors found that 88.4% of women who underwent LGE had active IBD, approximately 63% of whom had moderate-to-severe disease activity. Findings from endoscopy resulted in a change in therapy in 78% of patients. This observation underscores the importance of endoscopic assessment during pregnancy if disease is active and findings will affect management.[22]

Note that the abovementioned studies are limited by small sample size and lack of extensive follow-up. In order to provide more comprehensive data and thus recommendations regarding the risk of adverse outcomes following endoscopy in pregnant women, Ludvigsson and colleagues published a large, nationwide cohort study in 2017 comparing outcomes in 3052 women who underwent some form of endoscopy during pregnancy to those in 1,589,173 controls over a 19 year period.[24] The primary outcomes included preterm birth, stillbirth, small for GA (SGA), and congenital malformations. The secondary outcomes included risk of IOL, LBW, need for CS, APGAR score less than 7 at 5 minutes, and neonatal death within 28 days of delivery. The authors deliberately evaluated women with lifetime histories of GI disease (ie, IBD in those getting LGEs) to reduce the likelihood that underlying disease, rather than the endoscopy itself, was the cause for adverse pregnancy outcomes. Women without GI disease histories were also included. Additionally, the authors compared women who underwent endoscopy during pregnancy to those who had an endoscopy less than 1 year before pregnancy to reduce bias that women being scoped during pregnancy were more likely to have more severe GI disease. They also examined outcomes in women who had an endoscopy less than 1 year before or after pregnancy but not during to determine the impact of underlying disease activity on adverse pregnancy events.[24]

In contrast to the other studies described, this study found that pregnant women who underwent endoscopy *were* at an increased risk for preterm delivery, IOL, need for CS, SGA, and LBW compared to pregnant controls and that these risks tended to be higher in women who underwent LGE compared to upper endoscopy. Interestingly, compared to colonoscopy during pregnancy, flexible sigmoidoscopy was associated with increased risk of preterm birth (relative risk [RR] 1.66, 95% confidence interval [CI] 1.06–2.60) but no other adverse events. The authors did not find that late endoscopy triggered childbirth, nor did they find an increased risk of SGA or congenital malformations based on trimester of endoscopy. When comparing women with a history of GI disease to those without, the authors found that both groups had an increased risk of adverse pregnancy outcomes associated with endoscopy, but

that these risks were higher in the GI disease group. Looking specifically at outcomes in women with and without IBD who underwent LGE during pregnancy, women with IBD had a significantly increased RR of all forms of preterm labor, IOL, need for CS, and LBW, while those without IBD had only increased RR of needing CS. When comparing women with endoscopy within 1 year before or after pregnancy to those who underwent endoscopy while pregnant, the authors found an increased risk of preterm birth and IOL in the endoscopy group. However, when the endoscopy group was limited to women *without* a history of GI disease, there was no increased risk of adverse outcomes. Additionally, when comparing the women who had endoscopy before or after (but not during) pregnancy to women with no endoscopy at any time, the former group had an increased risk of multiple adverse outcomes, including preterm delivery, IOL, need for CS, stillbirth, APGAR less than 7, LBW, and major congenital malformations. Overall, the authors concluded that many of the adverse outcomes they observed were more likely due to underlying active GI disease than related to endoscopy itself. Moreover, while adverse outcomes were appreciated, they were relatively rare and unrelated to trimester of pregnancy.[24]

PEDIATRICS

The incidence of pediatric-onset IBD is increasing worldwide.[28] Although pediatric-onset IBD may sometimes present similar clinical and endoscopic features as those in adults, children may have distinct disease phenotypes with significant implications in diagnosis and treatment strategies. For instance, pediatric patients with UC may present with patchy disease and relative or absolute rectal sparing, a feature not commonly seen in adult-onset UC.[29,30] Furthermore, isolated colonic Crohn's disease (CD) is more common in children, particularly those younger than 8 years of age.[31] These distinguishing features unique to pediatric IBD have prompted the development of position papers by pediatric gastroenterology societies, including a position paper on endoscopy in pediatric IBD by the Porto IBD group to specifically address these important considerations.[32] This section focuses on the aspects of endoscopy that are unique to the diagnosis, monitoring, and management of IBDs in the pediatric population.

Diagnostic Endoscopy

Differentiating CD from UC in pediatric-onset IBD can be challenging given disease behavior and distribution differences previously discussed. The evaluation of pediatric patients with high suspicion for IBD should be thorough. The endoscopic assessment should include esophagogastroduodenoscopy (EGD) and colonoscopy with ileal intubation (ileocolonoscopy [IC]). Given the higher incidence of more proximal involvement of CD in pediatric IBD, ileal intubation is essential and could confirm a diagnosis of CD with ileal inflammation. An EGD should also be performed in the presence or absence of upper GI symptoms. Histology from biopsies obtained during the EGD may reveal specific findings suggesting CD (ie, chronic gastritis/duodenitis associated with granulomas). A pediatric IBD study showed that characteristic lesions for CD were noted in 31% of patients with CD and that completing an EGD helped to establish the final diagnosis in 9% of children with IBD.[33] It is important to note that nonspecific gastritis and duodenitis are not diagnostic of CD and may be considered atypical findings in patients with UC.[30,34] It is also recommended that the endoscopist obtain at least 2 biopsies from each individual segment (ie, >2 biopsies each from the esophagus, stomach and duodenum, and from the terminal ileum, cecum, transverse colon, sigmoid colon, and rectum). Given the importance of a complete and thorough

evaluation and focus on making the most accurate diagnosis possible, the endoscopic evaluation in a pediatric patient with a reasonable concern for IBD should be performed by an endoscopist trained in pediatric gastroenterology.[35]

Monitoring

There are limited data on periodic disease reassessment in pediatrics. Current data and expert opinion suggest endoscopic monitoring for the following indications: (1) before any major treatment changes, including therapy escalation and (2) to ensure mucosal healing after starting or changing therapy, particularly for CD.[32] The assessment of therapy response is recommended between 6 and 12 months after initiating treatment, considering earlier evaluation in higher risk patients. For pediatric UC, utilization of a validated disease activity index and a FC may be considered sufficient to assess response to therapy and could potentially prevent repeat colonoscopies in the setting of clinical remission. The pediatric UC activity index (PUCAI) score has been developed and validated to assess disease activity in pediatric UC.[36–38] Clinicians may defer a colonoscopy if both FC and PUCAI scores are normal. In instances where there is a normal FC but a positive PUCAI score, endoscopy is recommended to determine whether symptoms are related to active inflammation. This should all be taken in the context of the individual patient presentation and using best clinical judgment. The accuracy of FC is less established for pediatric CD and endoscopic re-evaluation to establish endoscopic and mucosal healing is recommended.

IUS is emerging as a valuable tool in the diagnostic and monitoring of IBD. Its diagnostic accuracy is comparable to that of other modes of cross-sectional imaging (ie, MRE).[39] Furthermore, it serves as a point-of-care tool that could be used in clinical decision-making during patient encounters. Given the need for serial monitoring in IBD, IUS is an attractive option with no requirement for ionizing radiation or sedation, features of particular relevance to pediatrics. Furthermore, the relatively lower incidence of truncal obesity in children makes this modality a feasible alternative to closely monitor disease activity during patient visits until (and after) treat-to-target IC is performed.[40]

As in adults, detailed and accurate documentation of endoscopic findings is critical for both diagnostic and monitoring endoscopic procedures. The use of endoscopic scores validated in the adult IBD population is recommended when feasible. These include the CD endoscopic index of severity, the Simple Endoscopic Scale for Crohn's Disease (SES-CD), and the UC endoscopic index of severity. It is important to recognize that there is large interobserver variability in the scoring of IBD lesions among pediatric endoscopists.[41] Thus, generalizability in the use of these scores may be limited in pediatric IBD. If scoring as above is not possible, the detailed documentation of mucosal findings and complications in each section during colonoscopy is strongly encouraged. It is important to keep in mind the atypical features of pediatric UC, including the possibility of rectal sparing and backwash ileitis. Backwash ileitis has been reported in up to 20% of patients with pancolitis and is generally seen in patients with pancolitis with cecal involvement.[30]

The recommendations discussed earlier, primarily in the setting of monitoring therapeutic response in UC, consider the yield of endoscopy against the potential risks associated to GA in the pediatric population and primarily in younger children. It is important to note that the use of GA is generally recommended in pediatric endoscopy practice, as it has been associated to decreased rates of immediate complications during endoscopy compared to other forms of IV sedation, including a lower risk of cardiorespiratory compromise.[42,43] The use of ketamine for anesthesia in the setting of GI endoscopy could be considered in patients with IBD with chronic pain managed

by opioids given its NMDA antagonistic properties. However, these limited benefits are hindered by associated undesirable side effects, including both psychomimetic (ie, delirium, psychosis, dissociation) and sympathomimetic (airway hypersecretions) effects, even at lower doses.[44] Furthermore, the recovery time of patients receiving ketamine as an anesthetic during endoscopy may be prolonged compared to those receiving propofol alone. The risks of anesthesia need to be balanced against the risks of unchecked inflammation by foregoing endoscopic assessment. More studies are needed to assess the latter risk.

Small Bowel Evaluation

Small bowel evaluation is crucial in patients with suspected CD. A few things should be considered in the pediatric population:

Up to 70% of pediatric patients with CD may have small bowel involvement.[45] Given the higher prevalence of Crohn's colitis compared to adults with IBD, full bowel assessment should be considered to clarify the diagnosis in patients with indeterminate colitis.

Capsule endoscopy (CE) can be performed in children as young as 2 years of age (reviewed in Ref[46]). In case series, CE has been shown to reclassify pediatric IBD from UC or indeterminate colitis to CD, which has implications for therapeutic management and follow-up. [47,48] In most scenarios, CE can be achieved through swallowing the capsule as done in the adolescent and adult population. Younger children or children who are unable to swallow the capsule for other reasons can undergo capsule deployment during an EGD.

Scoring systems for CE have been used in small pediatric studies with variable success. A newer method, the CE-CD has been well-validated in adults. A retrospective study evaluating the CE-CD score showed promising results in pediatric IBD.[49] Prospective studies are needed to further determine the validity of endoscopic scores in the pediatric population. Data on the use of enteroscopy in pediatrics are limited. Potential applications in IBD include diagnostics, such as tissue acquisition from mid-small bowel, or therapeutic procedures such as management of small bowel strictures (ie, balloon dilation). Single-balloon enteroscopy has been shown to be a safe and effective procedure for the evaluation and treatment of small bowel disease in children.[50,51] Furthermore, it was shown to be of high yield in the diagnosis of disease in the setting of concerning symptoms, such as GI bleeding with weight loss or diarrhea, which included diagnosing CD in these patients. Double-balloon enteroscopy has also been shown to be safe and useful in the diagnosis and management of small bowel disease in children, including small bowel IBD, albeit in a limited number of patients.[52,53]

Overall, enteroscopy is rarely performed in children with IBD. Its use is also limited by availability and expertise in pediatric centers and will often be performed by adult endoscopists. CE is currently preferred over enteroscopy for assessment of small bowel involvement in CD unless otherwise contraindicated.

Colorectal Cancer Surveillance

There are limited data on the risk of colorectal cancer (CRC) in the pediatric population with IBD. Guidelines from the Porto group suggest cancer surveillance in pediatric UC after 10 years of disease onset. Risk factors prompting surveillance every 8 years (in children >16 year) include extensive colitis, high burden of colitis over time, and family history of CRC in a first-degree relative at less than 50 years of age. These risk factors also help determine surveillance intervals, and these guidelines suggest the following: annual screening if greater than 2 risk factors; every 3 years if greater than 1 risk factor;

and every 5 years if no risk factors.[32] The endoscopic techniques utilized for CRC screening in pediatric patients with IBD, including the use of high-definition IC and chromoendoscopy, are based on adult guidelines.

A concomitant diagnosis of primary sclerosing cholangitis (PSC) and IBD increases the risk of CRC. In the pediatric population with PSC-IBD, a retrospective study found a 5 year probability of CRC of 0.8% (95% CI, 0.3%–2.7%) and the 10 year probability of developing CRC after diagnosis of 4.8% (95% CI, 2.0%–11.1%).[54] A position statement released by the American Association for the Study of Liver Diseases suggests initiating CRC surveillance every 1 to 2 years starting at the time of PSC-IBD diagnosis.[55] CRC is rare in patients with PSC under 15 years of age; therefore, initiating surveillance at 15 years of age in patients diagnosed with PSC-IBD is reasonable.

SUMMARY

Endoscopy in the hospitalized patient with ASUC can help prognosticate the course of disease and the benefits appear to outweigh the risks. Full colonoscopy is rarely needed and flexible sigmoidoscopy is likely adequate. Data exploring the safety of bowel preparation, sedation in endoscopy, and endoscopy itself in pregnancy are relatively limited and largely retrospective. Nonetheless, available data support the use of endoscopy during pregnancy if findings are expected to impact clinical decision making. All decisions regarding endoscopy—including procedural timing, sedation, and fetal monitoring—should be made in partnership with the patient's OB. Additional, prospective studies with larger sample sizes would be helpful to identify specific risk factors for adverse outcomes related to LGE in pregnant patients with IBD.

Pediatric patients with IBD represent a unique subset of IBD with clinical and endoscopic presentations that may differ from those of adult-onset IBD. Given the limited data in this population, much of our current diagnostic practice is derived from adult studies. The standard of care should include accurate in detail documentation of endoscopic findings, as this is critical to establish an appropriate diagnosis and for follow-up of medical therapies or repeat endoscopic assessments. However, it is important to understand the innate differences that pertain to children in order to make appropriate diagnoses. Diagnostic accuracy is critical for both therapeutic and monitoring decision-making in these patients, with implications in their quality of life. More studies in pediatrics are warranted to better formulate appropriate guidelines addressing this population's unique needs.

CLINICS CARE POINTS

- Endoscopy in patient with ASUC is low risk if done for appropriate clinical decision-making.
- Endoscopy should be performed early in the hospitalization to optimize outcomes.

LGE is generally considered safe in pregnancy (particularly a flexible sigmoidoscopy without sedation), but should be reserved for patients with strong indications (ie, making a new diagnosis of IBD, or if the procedure will change management).

- IUS is comparably accurate to both colonoscopy and MRE and can often be used in place of LGE to assess disease activity and response to treatment during pregnancy.
- Data regarding safety and efficacy of bowel preparations during pregnancy are minimal; based on mechanism of action and limited available data, PEG formulations appear to be the safest option.

- Most sedative agents typically used during endoscopy in nonpregnant patients are likely safe during pregnancy, though it is preferable to perform a flexible sigmoidoscopy when possible, as this eliminates the need for sedation altogether. If sedation is needed, it should be administered in a controlled, highly monitored setting by an anesthesiologist, following discussion with an MFM.
- Endoscopic evaluation in a child suspected of having IBD should be performed by an experienced endoscopist trained in pediatric gastroenterology.
- Small bowel evaluation is critical in patients with concerns for CD, including patients with indeterminate colitis utilizing cross-sectional imaging (ie, enterography) or CE.
- CRC surveillance should initiate at 10 years after disease onset in pediatric UC. Subsequent surveillance is determined based on risk factor assessment, including family history of CRC and burden and extent of disease involvement.
- In the case of PSC-IBD, we suggest initiating CRC surveillance every 1 to 2 years at the time of PSC-IBD diagnosis, starting at 15 years of age.

DISCLOSURE

Z. Gottlieb has research support from Pfizer. S. Kane is a consultant to Boerhinger Ingleheim, Bristol Meyers Squibb, Fresenius Kabi, IAssessments, InveniAI, Janssen, Kinetix Group, Lilly, and Takeda. Section Editor UptoDate.

REFERENCES

1. Makkar R, Bo S. Colonoscopic perforation in inflammatory bowel disease. Gastroenterol Hepatol 2013;9(9):573–83.
2. Alemayehu G, Jarnerot G. Colonoscopy during an attack of severe ulcerative colitis is a safe procedure and of great value in clinical decision making. Am J Gastroenterol 1991;86(2):187–90.
3. Carbonnel F, Lavergne A, Lémann M, et al. Colonoscopy of acute colitis. a safe and reliable tool for assessment of severity. Dig Dis Sci 1994;39(7):1550–7.
4. Borren NZ, Khalili H, Luther J, et al. Second-look endoscopy in hospitalized severe ulcerative colitis: a retrospective cohort study. Inflamm Bowel Dis 2019; 25(4):750–5.
5. Grant RK, Jones GR, Plevris N, et al. The ACE (albumin, crp and endoscopy) index in acute colitis: a simple clinical index on admission that predicts outcome in patients with acute ulcerative colitis. Inflamm Bowel Dis 2021;27(4):451–7.
6. Sharma S, Li DK, Levine LJ, et al. Early flexible sigmoidoscopy improves clinical outcomes in acute severe ulcerative colitis. Crohns Colitis 360 2023;5(3): otad032.
7. Mahadevan U, Robinson C, Bernasko N, et al. Inflammatory bowel disease in pregnancy clinical care pathway: a report from the american gastroenterological association ibd parenthood project working group. Am J Obstet Gynecol 2019; 220(4):308–23.
8. Shergill AK, Shergill AK, Ben-Menachem T, et al. Guidelines for endoscopy in pregnant and lactating women. Gastrointest Endosc 2012;76(1):18–24.
9. Allocca M, Furfaro F, Fiorino G, et al. Point-of-care ultrasound in inflammatory bowel disease. J Crohns Colitis 2021;15(1):143–51.
10. De Voogd F, Joshi H, Van Wassenaer E, et al. Intestinal ultrasound to evaluate treatment response during pregnancy in patients with inflammatory bowel disease. Inflamm Bowel Dis 2022;28(7):1045–52.

11. Flanagan E, Wright EK, Begun J, et al. Monitoring inflammatory bowel disease in pregnancy using gastrointestinal ultrasonography. J Crohns Colitis 2020;14(10):1405–12.
12. Dolinger MT, Kayal M. Intestinal ultrasound as a non-invasive tool to monitor inflammatory bowel disease activity and guide clinical decision making. World J Gastroenterol 2023;29(15):2272–82.
13. ACOG Committee Opinion No. 775: nonobstetric surgery during pregnancy. Obstet Gynecol 2019;133(4):e285–6.
14. Soma-Pillay P, Nelson-Piercy C, Tolppanen H, et al. Physiological changes in pregnancy. Cardiovasc J Afr 2016;27(2):89–94.
15. Patel V, Nicar M, Emmett M, et al. Intestinal and renal effects of low-volume phosphate and sulfate cathartic solutions designed for cleansing the colon: pathophysiological studies in five normal subjects. Am J Gastroenterol 2009;104(4):953–65.
16. US Food and Drug Administration. FDA issues final rule on changes to pregnancy and lactation labeling information for prescription drug and biological products 2015. p. 247–56.
17. Neri I, Blasi I, Castro P, et al. Polyethylene glycol electrolyte solution (Isocolan) for constipation during pregnancy: an observational open-label study. J Midwifery Womens Health 2004;49(4):355–8.
18. de Lima A, Zelinkova Z, van der Woude CJ. A prospective study of the safety of lower gastrointestinal endoscopy during pregnancy in patients with inflammatory bowel disease. J Crohns Colitis 2015;9(7):519–24.
19. Cappell MS. Risks versus benefits of gastrointestinal endoscopy during pregnancy. Nat Rev Gastroenterol Hepatol 2011;8(11):610–34.
20. Bonnet MP. Sedation and anaesthesia for non-obstetric surgery. Anaesth Crit Care Pain Med 2016;35(Suppl 1):S35–41.
21. Cappell MS, Colon VJ, Sidhom OA. A study at 10 medical centers of the safety and efficacy of 48 flexible sigmoidoscopies and 8 colonoscopies during pregnancy with follow-up of fetal outcome and with comparison to control groups. Dig Dis Sci 1996;41(12):2353–61.
22. Ko MS, Rudrapatna VA, Avila P, et al. Safety of flexible sigmoidoscopy in pregnant patients with known or suspected inflammatory bowel disease. Dig Dis Sci 2020;65(10):2979–85.
23. Ravindra GL, Madamangalam AS, Seetharamaiah S. Anaesthesia for non-obstetric surgery in obstetric patients. Indian J Anaesth 2018;62(9):710–6.
24. Ludvigsson JF, Lebwohl B, Ekbom A, et al. Outcomes of pregnancies for women undergoing endoscopy while they were pregnant: a nationwide cohort study. Gastroenterology 2017;152(3):554–63.e9.
25. De Lima A, Galjart B, Wisse PHA, et al. Does lower gastrointestinal endoscopy during pregnancy pose a risk for mother and child? - a systematic review. BMC Gastroenterol 2015;15:15.
26. Cappell MS, Sidhom O. Multicenter, multiyear study of safety and efficacy of flexible sigmoidoscopy during pregnancy in 24 females with follow-up of fetal outcome. Dig Dis Sci 1995;40(2):472–9.
27. Cappell MS, Fox SR, Gorrepati N. Safety and efficacy of colonoscopy during pregnancy: an analysis of pregnancy outcome in 20 patients. J Reprod Med 2010;55(3–4):115–23.
28. Kuenzig ME, Fung SG, Marderfeld L, et al. Twenty-first century trends in the global epidemiology of pediatric-onset inflammatory bowel disease: systematic review. Gastroenterology 2022;162(4):1147–59.e4.

29. Glickman JN, Bousvaros A, Farraye FA, et al. Pediatric patients with untreated ulcerative colitis may present initially with unusual morphologic findings. Am J Surg Pathol 2004;28(2):190–7.
30. Levine A, de Bie CI, Turner D, et al. Atypical disease phenotypes in pediatric ulcerative colitis: 5-year analyses of the EUROKIDS Registry. Inflamm Bowel Dis 2013;19(2):370–7.
31. Heyman MB, Kirschner BS, Gold BD, et al. Children with early-onset inflammatory bowel disease (IBD): analysis of a pediatric IBD consortium registry. J Pediatr 2005;146(1):35–40.
32. Oliva S, Thomson M, de Ridder L, et al. Endoscopy in pediatric inflammatory bowel disease: a position paper on behalf of the porto IBD group of the european society for pediatric gastroenterology, hepatology and nutrition. J Pediatr Gastroenterol Nutr 2018;67(3):414–30.
33. Kovacs M, Muller KE, Arato A, et al. Diagnostic yield of upper endoscopy in paediatric patients with Crohn's disease and ulcerative colitis. Subanalysis of the HUPIR registry. J Crohns Colitis 2012;6(1):86–94.
34. Tobin JM, Sinha B, Ramani P, et al. Upper gastrointestinal mucosal disease in pediatric Crohn disease and ulcerative colitis: a blinded, controlled study. J Pediatr Gastroenterol Nutr 2001;32(4):443–8.
35. Tringali A, Thomson M, Dumonceau JM, et al. Pediatric gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) Guideline Executive summary. Endoscopy 2017;49(1):83–91.
36. Turner D, Hyams J, Markowitz J, et al. Appraisal of the pediatric ulcerative colitis activity index (PUCAI). Inflamm Bowel Dis 2009;15(8):1218–23.
37. Dotson JL, Crandall WV, Zhang P, et al. Feasibility and validity of the pediatric ulcerative colitis activity index in routine clinical practice. J Pediatr Gastroenterol Nutr 2015;60(2):200–4.
38. Schechter A, Griffiths C, Gana JC, et al. Early endoscopic, laboratory and clinical predictors of poor disease course in paediatric ulcerative colitis. Gut 2015;64(4):580–8.
39. Horsthuis K, Bipat S, Bennink RJ, et al. Inflammatory bowel disease diagnosed with US, MR, scintigraphy, and CT: meta-analysis of prospective studies. Radiology 2008;247(1):64–79.
40. Kellar A, Dolinger M, Novak KL, et al. Intestinal ultrasound for the pediatric gastroenterologist: a guide for inflammatory bowel disease monitoring in children: expert consensus on behalf of the international bowel ultrasound group (IBUS) pediatric committee. J Pediatr Gastroenterol Nutr 2023;76(2):142–8.
41. Norsa L, Ferrari A, Arrigo S, et al. Scoring endoscopy in pediatric inflammatory bowel disease: a way to improve quality. J Pediatr Gastroenterol Nutr 2021;73(1):48–53.
42. Thakkar K, El-Serag HB, Mattek N, et al. Complications of pediatric colonoscopy: a five-year multicenter experience. Clin Gastroenterol Hepatol 2008;6(5):515–20.
43. Dillon M, Brown S, Casey W, et al. Colonoscopy under general anesthesia in children. Pediatrics 1998;102(2 Pt 1):381–3.
44. White JM, Ryan CF. Pharmacological properties of ketamine. Drug Alcohol Rev 1996;15(2):145–55.
45. Oliva S, Aloi M, Viola F, et al. A treat to target strategy using panenteric capsule endoscopy in pediatric patients with crohn's disease. Clin Gastroenterol Hepatol 2019;17(10):2060–2067 e1.
46. Cohen SA, Oliva S. Capsule endoscopy in children. Front Pediatr 2021;9:664722.

47. Cohen SA, Gralnek IM, Ephrath H, et al. Capsule endoscopy may reclassify pediatric inflammatory bowel disease: a historical analysis. J Pediatr Gastroenterol Nutr 2008;47(1):31–6.
48. Joshi SS, Vyas AK, Vyas D, et al. Reclassifying inflammatory bowel disease with capsule endoscopy in children. J Pediatr (Rio J) 2013;89(5):514–5.
49. Oliva S, Veraldi S, Cucchiara S, et al. Assessment of a new score for capsule endoscopy in pediatric Crohn's disease (CE-CD). Endosc Int Open 2021;9(10):E1480–90.
50. Reddy PM, Kulkarni S, Nabi Z, et al. Single balloon enteroscopy in children for evaluation of small bowel diseases in children: A large, tertiary center study. J Pediatr Surg 2021;56(11):2005–9.
51. Di Nardo G, Oliva S, Aloi M, et al. Usefulness of single-balloon enteroscopy in pediatric Crohn's disease. Gastrointest Endosc 2012;75(1):80–6.
52. Nishimura N, Yamamoto H, Yano T, et al. Safety and efficacy of double-balloon enteroscopy in pediatric patients. Gastrointest Endosc 2010;71(2):287–94.
53. Chen H, Liu Y, Fu L, et al. Clinical utility of double-balloon enteroscopy in children: A single-centre experience in South China. J Paediatr Child Health 2019;55(2):188–93.
54. El-Matary W, Guthery SL, Amir AZ, et al. Colorectal dysplasia and cancer in pediatric-onset ulcerative colitis associated with primary sclerosing cholangitis. Clin Gastroenterol Hepatol 2021;19(5):1067–70.e2.
55. Bowlus CL, Arrivé L, Bergquist A, et al. AASLD practice guidance on primary sclerosing cholangitis and cholangiocarcinoma. Hepatology 2023;77(2):659–702.
56. Shin J. Anesthetic management of the pregnant patient: part 2. Anesth Prog 2021;68(2):119–27.
57. Cappell MS. Sedation and analgesia for gastrointestinal endoscopy during pregnancy. Gastrointest Endosc Clin N Am 2006;16(1):1–31.