Communication from the ASGE Standards of Practice Committee

NASPGHAN North American Society for Pediatric Gastroenterology, Hepatology and Nutrition

GUIDELINE

American Society for Gastrointestinal Endoscopy ASGE

Modifications in endoscopic practice for pediatric patients

This is one of a series of statements discussing the use of GI endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy (ASGE) prepared this text. In preparing this guideline, a search of the medical literature published 1980–2013 was performed by using PubMed. Additional references were obtained from the bibliographies of the identified articles and from recommendations of expert consultants. When few or no data exist from well-designed prospective trials, emphasis is given to results from large series and reports from recognized experts. Guidelines for appropriate use of endoscopy are based on a critical review of the available data and expert consensus at the time that the guidelines are drafted. Further controlled clinical studies may be needed to clarify aspects of this guideline. This guideline may be revised as necessary to account for changes in technology, new data, or other aspects of clinical practice. The recommendations are based on reviewed studies and are graded on the strength of the supporting evidence[1] (Table 1). The strength of individual recommendations is based on both the aggregate evidence quality and an assessment of the anticipated benefits and harms. Weaker recommendations are indicated by phrases such as "We suggest…," whereas stronger recommendations are typically stated as "We recommend…."

This guideline is intended to be an educational device to provide information that may assist endoscopists in providing care to patients. This guideline is not a rule and should not be construed as establishing a legal standard of care or as encouraging, advocating, requiring, or discouraging any particular treatment. Clinical decisions in any particular case involve a complex analysis of the patient's condition and available courses of action. Therefore, clinical considerations may lead an endoscopist to take a course of action that varies from these guidelines.

Ensuring safe and effective endoscopy in pediatric populations requires adequate medical knowledge and technical competency specific to performing GI procedures in children.[2] Endoscopy in patients who range in age from neonates through adolescents is usually performed in the United States by pediatric endoscopists who have been trained in accredited fellowship programs.[2] However, there are situations in which surgeons or adult gastroenterologists may be asked to perform endoscopy in children. Typically, such consultation is obtained to provide advanced therapeutic endoscopic services (eg, ERCP) and ideally involves a team approach between pediatric gastroenterologists and advanced endoscopists.[3] This document is intended to provide guidance regarding practice issues surrounding performing endoscopy in children. Many of the practice modifications required are related to the smaller size of pediatric patients, and, as physiologic age is a continuum, this document is not intended to apply to rigidly defined age ranges. Where useful, body weights and ages will be specified.

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INDICATIONS AND CONTRAINDICATIONS

Diagnostic and therapeutic endoscopic procedures, including esophagogastroduodenoscopy (EGD), colonoscopy, polypectomy, hemostatic therapy, balloon dilation, and placement of PEG tubes are fundamental to the assessment, treatment, and care of infants and children with a vast number of GI conditions. In terms of diagnostic procedures, EGD may be specifically useful to evaluate for the possibility of common pediatric conditions such as allergic, infectious, or peptic esophagitis; infectious or inflammatory gastritis; and celiac disease.[4] Colonoscopy is most commonly performed in infants and children when entertaining a diagnosis of inflammatory bowel disease,[5] but may also be used to identify common sources of rectal bleeding, including juvenile polyps.[6,7]

A key difference between pediatric and adult diagnostic procedures is that routine tissue sampling is performed in children from at least the duodenum, stomach, and esophagus during endoscopy and from the colon and terminal ileum during colonoscopy with ileoscopy.[8,9] It is standard pediatric endoscopy practice to err on the side of obtaining biopsy specimens, even in the absence of gross abnormalities, because the risks of sedation and performing repeat endoscopy in pediatric populations are considered to outweigh the risks of obtaining biopsy specimens.[10] Several studies have also shown that it may be particularly difficult to rule out clinically significant disease based on endoscopic appearance of the upper GI tract in children, and biopsies during pediatric EGD are generally considered necessary even in the absence of any gross endoscopic findings.[8,9,11]

TABLE 1. GRADE system for rating the quality of evidence for guidelines[1]

Quality of evidence	Definition	Symbol
High quality	Further research is very unlikely to change our confidence in the estimate of effect	⊕⊕⊕⊕
Moderate quality	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate	⊕⊕⊕○
Low quality	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate	⊕⊕○○
Very low quality	Any estimate of effect is very uncertain	⊕○○○

Infants and children are unlikely to localize their symptoms to the upper GI tract, and there are a number of nonspecific signs and symptoms that may prompt upper endoscopy in young children, including failure to thrive, limitation of usual activities, unexplained irritability, and anorexia.[11] Common indications for EGD in children are summarized in Table 2 and those for colonoscopy are shown in Table 3. There is no pediatric colon cancer screening guideline, and therefore patient volume of pediatric colonoscopies at the population level is far lower than that of adults. More uncommon, but nevertheless critically important, indications for colonoscopy in children include surveillance for neoplasia in children with long-standing inflammatory bowel disease[5] and hereditary polyposis syndromes[12] as well as for graft-versus-host disease.[13,14]

There are few contraindications to performing endoscopic procedures in children. The size of the patient is rarely a contraindication, and both upper and lower endoscopic examinations can be performed safely in neonates as small as 1.5 to 2 kg.[11,15] Relative contraindications include coagulopathy, neutropenia, and unstable cardiopulmonary disease. In patients with these conditions, it is important to ascertain whether the benefits of performing the procedure outweigh its risks.[16,17]

GI endoscopic procedures are generally *not* indicated in infants for the evaluation of uncomplicated GERD or congenital hypertrophic pyloric stenosis. They are also generally not indicated in older children for evaluation of functional GI disorders, including self-limited abdominal pain, constipation, and encopresis.[4] Upper endoscopy as an ambulatory procedure in otherwise healthy children 1 year of age and older is safe,[18] although discharge instructions should address sore throat and hoarseness, which may occur after the procedure in as many as one third of patients.[19]

Indications for ERCP in children are similar to those for adults, but the procedure is required far less frequently per capita and with a much lower incidence of malignant diseases.[20,21] Biliary indications include choledocholithiasis, primary sclerosing cholangitis, choledochal cyst, biliary strictures, bile plug syndrome, intra- or extrahepatic ductal dilation, and bile leak after liver transplantation or cholecystectomy.[20,22-24] Pancreatic indications for ERCP include persistent acute pancreatitis, recurrent episodes of acute pancreatitis, chronic pancreatitis, pancreatic divisum, annular pancreas, and pancreatic trauma.[25-29] Technical success rates for diagnostic and therapeutic ERCP in infants and children are high, with adverse event rates similar to those in adults.[20,21] One retrospective review of 343 ERCPs performed in 224 patients younger than 18 years of age found that although therapeutic procedures were more often associated with post-ERCP pancreatitis than diagnostic ERCP, the overall prevalence of this adverse event of ERCP in children was 2.5%.[30]

EUS may be indicated in pediatric patients for the evaluation of upper GI tract tumors and pancreatic disorders, characterization of esophageal strictures, and for evaluation of enteric duplications.[31-34] Use of a miniprobe that can be passed through conventional endoscopes has increased the potential utility of EUS in infants and children.[35] EUS may be particularly important in the assessment of submucosal lesions, and its indications include cancer staging and pancreatic and biliary disease. Rectal EUS may be useful to evaluate for anorectal malformations[36] and fistulizing inflammatory bowel disease.[37]

Indications for capsule endoscopy in children include obscure GI bleeding, suspected Crohn's disease, celiac disease, and small-bowel polyps in patients with hereditary polyposis syndromes.[38-40] Wireless capsule endoscopy in children is safe and well tolerated and has been approved by the U.S. Food and Drug Administration for children 2 years of age and older.[41,42] Endoscopic placement can be performed for children who cannot swallow the capsule.[43] The main risk associated with capsule endoscopy is capsule retention, which has been reported to occur in less than 1% of pediatric patients.[40]

Single- or double-balloon small-bowel enteroscopy may allow adequate inspection with tissue sampling or therapeutic procedures throughout the entire upper GI tract and small intestine. Either approach may be indicated to evaluate for small-bowel involvement in pediatric Crohn's disease as well as to treat small-bowel strictures or vascular lesions in children who weigh at least 10 kg.[44-46] One study found the diagnostic yield of small-bowel enteroscopy to be greater than that of magnetic resonance imaging

TABLE 2. Common indications for upper endoscopy in children

Diagnostic
Dysphagia
Odynophagia
Intractable or chronic symptoms of GERD
Vomiting/hematemesis
Persistent epigastric pain
Unexplained irritability
Anorexia
Weight loss/failure to thrive
Anemia (unexplained)
Diarrhea/malabsorption (chronic)
GI bleeding
Caustic ingestion
Therapeutic
Foreign-body removal
Stricture dilation
Esophageal variceal ligation
Upper GI bleeding control

(MRI) or US to detect small-bowel inflammation in pediatric Crohn's disease.[46] Laparoscopically assisted double-balloon enteroscopy may be integrated into minimally invasive bowel surgery in children to treat a variety of small-bowel pathologies, including small-bowel diaphragm disease and blue rubber bleb syndrome.[47]

Upper endoscopy for common ingestions of childhood

Two other common pediatric circumstances that may require endoscopy are the ingestion of foreign bodies and caustic substances. The protocol for endoscopic evaluation of foreign-body ingestion is similar to that in adults and has been well-described elsewhere.[48] Compared with standard practice in adults, it is generally recommended that foreign-body removal in children be done while they are under general anesthesia with endotracheal intubation to protect the airway from aspiration. Emergent foreign-body removal in children is indicated for any symptomatic esophageal foreign body and for asymptomatic esophageal button batteries because of the high risk of esophageal tissue necrosis and risk of fistula formation.[49,50]

Another increasingly common indication for emergent foreign-body removal in children is ingestion of powerful, rare-earth neodymium magnets, often manufactured as toys. Neodymium magnets have been reported in recent years to be increasingly accidentally ingested not only by toddlers, but also by adolescents, who use them to mimic jewelry piercings of their tongue and nose.[51] Ingestion of 2 or more magnets has been associated with significant risks of obstruction, perforation, and fistula development of the upper and lower GI tracts, necessitating surgical intervention and even bowel resection.[52] An algorithm to assist emergency department physicians and gastroenterologists in providing timely care, including endoscopic removal of magnets, was recently published and endorsed by the North American Society of Pediatric Gastroenterology, Hepatology, and Nutrition.[53]

Caustic substances most commonly ingested include alkali (lyes), alkaline batteries, bleaches, and laundry detergents.[54,55] Acids are found in toilet bowl cleaners, metal cleaners, and battery acids. In the United States, it is advisable to contact the American Association of Poison Control Centers (http://www.aapcc.org) at their toll-free number 800-222-1222 on patient presentation for assistance in identifying the caustic substance and management recommendations.[56] It is mandatory to report history and physical examination findings suggestive of child abuse or neglect to local child protective services.[54]

In cases of witnessed ingestion of caustic substances in which patients are manifesting symptoms, upper endoscopy should be performed to assess for esophageal, gastric, and duodenal injury.[54,57] Universal performance of EGD in the setting of unwitnessed caustic ingestion without evidence of oropharyngeal injury is controversial, especially in asymptomatic patients, defined as having an absence of drooling, vomiting, stridor, hematemesis, dysphagia, or abdominal pain.[55,58] Nevertheless, there is a well-recognized lack of correlation between symptoms of caustic ingestion and degree of esophageal injury.[54]

An endoscopic grading system for the severity of caustic ingestion has been proposed (Table 4).[54] Endoscopy within 24 hours of caustic ingestion is generally considered safe and provides important prognostic information.[59,60] Use of a grading system also allows for stratification of therapy. Patients with grade 1 and 2a burns generally do well without aggressive therapy, whereas those with grade 2b and 3 lesions are at risk of adverse events.[54,60] In addition, 1 study compared early bougienage (performed during the first week after ingestion) with late bougienage (after the third week, if strictures had developed) in grade 2b and 3 patients.[61] Early bougienage did not prevent strictures, but any strictures that did occur in the early group appeared to respond more readily to subsequent dilation.[61]

PREPROCEDURE PREPARATION

Preparation for endoscopy in pediatric patients requires attention to physiologic issues as well as the emotional and psychosocial well-being of both patients and their primary

TABLE 3. Common indications for colonoscopy in children

Diagnostic
Chronic or profuse diarrhea
Suspected lower GI bleeding
Unexplained anemia
Polyposis syndrome (diagnosis and surveillance)
Failure to thrive/weight loss
Therapeutic
Polypectomy
Foreign-body removal
Dilation of strictures
Hemostasis

TABLE 4. Endoscopic grading of caustic injury severity

Grade 0: normal
Grade 1 (superficial): edema and hyperemia of mucosa
Grade 2a (transmucosal): hemorrhage; exudate, erosions and blisters, superficial ulcers
Grade 2b: grade 2a plus deep discrete or circumferential ulceration
Grade 3 (transmural): deep ulceration, eschar formation with necrosis, full-thickness injury with and without perforation

caregiver(s).[62] Informed consent should be obtained from an appropriately designated parent or guardian, as stipulated by state regulation or statute, and assent should be obtained when appropriate in older children. A recent prospective, randomized trial in a pediatric endoscopy unit suggests that novel, interactive electronic programs may represent ethically compelling means of improving consenting processes, as reflected in increased patient satisfaction.[63]

According to the American Academy of Pediatrics (AAP), a preprocedure health evaluation specific to elective procedures should be obtained that includes a health history, American Society of Anesthesiology score of physical status, medication history, allergy assessment, age, weight, and baseline vital signs.[64] One prospective trial has suggested that such an evaluation before endoscopy may reduce the adverse events associated with sedation.[65] Multiple patient risk factors that may affect pediatric endoscopy include the presence of sepsis, shock, dehydration, electrolyte imbalance, acute and chronic respiratory conditions, underlying cardiovascular diseases (especially cyanotic congenital heart disease), acute and chronic neurological conditions, liver, and renal dysfunction. A physical examination including a focused assessment of the heart, circulation, lungs, head, neck, and airway should be performed.[64] Laboratory tests are not required in the preprocedure assessment and need only be performed for clinical indications.

Endocarditis prophylaxis should be considered in some patients with congenital heart disease, in particular, those with significant valve lesions and those with surgically placed shunts or artificial material in their circulation.[66,67] Routine endoscopy with or without biopsy does not warrant routine antibiotic prophylaxis. Guidelines for clinical situations that are commonly encountered in hospitalized children, such as ventriculoperitoneal shunts, central venous lines, and immunosuppression, have not been developed.

Pediatric patients with presumed normal gastric emptying should fast before elective sedation for a minimum of 2 hours after ingesting clear liquids.[64,68] Individual institutions often have specific preprocedure fasting guidelines for solids. The AAP guideline on sedation follows the recommendations of the American Society of Anesthesiology for general anesthesia and advises fasting from breast milk for 4 hours and from formula, nonhuman milk, and solids for 6 hours before elective sedation.[64] The risks of sedation without appropriate fasting in emergent cases must be weighed against the necessity for the procedure and the expected benefit. Prolonged fasts without fluids are more difficult for young children, so morning procedures and timely schedules are desirable.

BOWEL PREPARATION FOR PEDIATRIC COLONOSCOPY

Bowel cleansing for colonoscopy in pediatric patients must prioritize safety and palatability and should take into account a patient's age, clinical state, and anticipated willingness or ability to comply.[69] To date, bowel preparation regimens for children have not been standardized and vary greatly among medical centers and individual practitioners. Most prospective and comparative studies of bowel preparation for pediatric colonoscopy have occurred at single centers.[70-75] Additionally, there is no validated pediatric colon cleanliness index.[69]

Ingestion of clear liquids for 24 hours and a normal saline solution enema (5 mL/kg) may suffice for infants younger than 2 years of age.[76] For children older than 2 years of age, cleansing can be accomplished with intestinal lavage by using osmotic agents, such as polyethylene glycol solutions with and without electrolytes, dietary restrictions, stimulant laxatives, such as senna and biscodyl, and/or enemas. Of note, sodium phosphate regimens (oral or enema) have been recognized to cause potentially fatal complications including fluid and electrolyte shifts leading to hypocalcemia, hyperphosphatemia, hyponatremia, nephrocalcinosis, and acute phosphate nephropathy, especially in patients with congestive heart failure or renal disease.[77] Although there are no data regarding specific safety risks of oral sodium phosphate in children, black-box warnings posted in 2008 from the U.S. Food and Drug Administration regarding its association with acute phosphate nephropathy have led to removal of this product as an over-the-counter precolonoscopy bowel preparation and at least 1 manufacturer to recommend against the use of oral sodium phosphate products for bowel preparation in any children younger than 18 years of age.[78,79]

If polyethylene glycol with electrolytes is to be used as the primary agent for bowel cleansing, most children will require approximately 80 mL/kg of the solution. Most will also be unlikely to ingest sufficient volume because of its noxious taste.[70] Administration of polyethylene glycol with electrolytes via a nasogastric tube in a hospital setting for 24 hours before the procedure is a safe and appropriate regimen, especially in children younger than 6 years of age.[76] PEG-3350 without electrolytes (eg, Miralax, Merck & Co., Inc., Whitehouse Station, NJ, USA) in doses as much as 10 times higher than those recommended for standard treatment of constipation is emerging as the preparation of choice in many pediatric units.[69] Several studies have reported on the safety and efficacy of 4-day bowel preparations by using PEG-3350 without electrolytes in children.[80,81] Other studies have concluded both 2-day[71,73,74] and 1-day[72,82] preparations are safe and effective. Table 5 lists several common and acceptable regimens for preparing children for colonoscopy.

INTRAPROCEDURAL SEDATION, ANALGESIA, AND MONITORING

Almost all GI procedures in children are performed while using endoscopist-administered moderate sedation or anesthesiologist-administered deep sedation and general anesthesia to ensure patient safety, comfort, and cooperation.[83,84] Many children may be highly anxious before sedation, which can complicate proceedings in the endoscopy unit.[85] Premedication with either oral (0.5 mg/kg)[86,87] or intranasal (0.2 mg/kg)[88] midazolam have both been shown in prospective, randomized, controlled trials to allow for easier intravenous line placement and easier separation from parents.

There are a number of physiologic differences between pediatric and adult patients that can alter risks of complications during sedation and general anesthesia. When ventilation is reduced by the prone or supine position, and especially by constraining garments or restraints, hypoventilation may occur.[89] Compared with adults, small and compliant pediatric airways yield significantly greater airflow resistance, which is further magnified by the addition of even modest amounts of mucus or edema. In children, the tongue fills the upper airway to a greater extent than in adults. Infants younger than 3 to 5 months are obligate nasal breathers. Tonsils and adenoids reach maximal proportions at around 5 to 7 years of age. Hence, children are prone to dynamic and static episodes of airway occlusion, with or without sedation.

Hyperreactive airways are known to occur during and for several weeks after upper respiratory infections and may be considered a contraindication to elective procedures requiring endotracheal intubation, although recent data suggest that this is not a definite contraindication.[90] In addition, because of proportionally higher oxygen consumption, episodes of hypoxemia are more poorly tolerated in children than in adults. Routine oxygen administration during pediatric procedures is a low-cost, high-benefit practice because data suggest that a significant proportion of children have transient apnea and that oxygen desaturation during sedation for endoscopy can develop.[89,91,92]

Children tend to tolerate proportional fluid excess or deficiency better than adults; however, their small size and obligate insensible fluid losses because of thinner skin and a greater surface-to-volume ratio predispose them to dehydration. The greater surface-to-volume ratio also predisposes them to more rapid heat loss and the potential for hypothermia during prolonged procedures. Although the short duration of most endoscopic procedures does not contribute greatly to dehydration or hypothermia, children should be well draped and room temperatures should be appropriately adjusted to avoid these possibilities.

After 6 months of age and in the absence of organ-specific pathology or dysfunction, sedative and analgesic drug effects and clearance are proportional to those observed in adults. Liver volume and proportional blood flow, relative to body weight, are significantly higher at birth in children than in adults. After early maturation of metabolic function, drug clearance is intact. Neurologically impaired patients, including children with trisomy 21, can be particularly sensitive to benzodiazepines and opiate/benzodiazepine combinations.

Administration of sedation in children should always be weight based and is generally titrated by response, allowing adequate time between doses to assess effects and the need for additional medication.[83,84] Despite anticipated differences in sedative doses and metabolism, requirements for individual patients may vary significantly. Higher relative doses may be ultimately required in the preschool, elementary, and preteenage groups compared with teenage patients.[93]

General anesthesia and propofol are commonly used for pediatric endoscopy, usually based on age or anticipated patient intolerance of the procedure. Increasing numbers of medical centers and pediatric gastroenterology practices

TABLE 5. Acceptable and common protocols for bowel cleansing before pediatric colonoscopy

Protocol	Dose and administration	Diet	Pros	Cons
PEG-ELS (short protocol)	100 mL/y of age/h × 4 h or 20 mL/kg/h (max rate of 1 L/h) × 4 h	Liberal until cleansing initiated, then clears only until procedure	Short preparation duration; short fasting period	Poor palatability and difficult to tolerate in most children; most will require inpatient setting for nasogastric tube administration
PEG-ELS (long protocol)	100 mL/y of age/h over 24 h or 20 mL/kg/h (max rate of 1 L/h) over 24 h	Liberal until cleansing initiated, then clears only until procedure	Well tolerated	Poor palatability; most children will require inpatient setting for nasogastric tube administration
Bisacodyl	2 doses 8-10 h apart on day before the procedure (5 mg/dose for <5 y old and 10 mg/dose for older children)	Clear fluids for 24 h	Well tolerated	Preparation may not be adequate
Picolax (sodium picosulfate with magnesium citrate)	Two doses 8-10 h apart on day before the procedure (0.25 sachet/dose for children <6 y, 0.5 sachet/dose for 6- to 12-y old children, and 1 sachet for children >12 y old)	Clear fluids for 24 h	Low-volume solution, palatable	Small risk of electrolyte imbalance and/or dehydration
PEG 3350 (long protocol)	1.5 g/kg/d (max dose: 100 g/d) over 4 d mixed in a commercially available sports drink	Liberal until day before procedure, final 24 h should be clear fluids	Well tolerated; safety well studied	Decreased quality of life
PEG-3350 (short protocol)	238 g OTC (255-g prescription) in 1.9 L of a commercially available sports drink over 2-4 h on the day before procedure	Liberal until prep initiated, then clear liquids only	Well tolerated; safety well studied	Requires patient/parent to be motivated

PEG-ELS, polyethylene glycol-electrolyte lavage solution; *max*, maximum; *OTC*, over-the-counter.

are predominantly working with anesthesia providers to perform endoscopy in children while the children are under general anesthesia and/or deep sedation with propofol.[94] Other indications may include the complexity of the planned procedure, physician preferences, patient comorbidities, or institutional guidelines.

The AAP has issued recommendations regarding sedation and monitoring for diagnostic and therapeutic procedures in children.[64] These guidelines recommend continuous pulse oximetry and heart rate monitoring at all levels of sedation by a dedicated trained attendant who is specifically assigned to monitor the patient's vital signs. In a prospective, randomized, controlled trial, integrating capnography into monitoring of nonintubated children receiving moderate sedation for pediatric endoscopy and colonoscopy was shown to reduce hypoxemia.[91] It should be noted that the training and licensure of monitoring personnel is often dictated by individual hospital or unit policies.[95] Most pediatric gastroenterologists are well trained and certified to provide moderate sedation, and most procedures can be safely performed outside the operating room.[96] However, because of the depth of sedation commonly required and the frequency of progression to deep sedation, personnel trained specifically in pediatric rescue maneuvers including airway management and pediatric advanced life support should be readily available.

All supplies necessary to rescue any child experiencing cardiovascular complications during a procedure should be readily available in any unit performing pediatric procedures. In addition, providers should be Pediatric Advanced Life Support certified and familiar with resuscitation protocols. Resuscitative equipment for pediatric endoscopy should reflect that which is available for adult endoscopy, with critical attention to the availability of devices of appropriate size (including blood pressure cuffs and endotracheal tubes) and drug doses for patients of all sizes and ages being treated. Necessary supplies also include pediatric-caliber intravenous tubing, arm boards, intravenous needles, face masks, oral and nasal airways, laryngoscopes, suction catheters, and nasogastric tubes. An emergency or code cart stocked for representative age groups should be readily available.

POSTPROCEDURE MONITORING AND DISCHARGE

After completion of endoscopic procedures, children should be monitored for adverse effects of the endoscopy or sedation. Vital signs and oxygen saturation should be monitored at specific intervals. The AAP has established recommended discharge criteria after sedation.[64] The child should be easily arousable, protective reflexes should be intact, and speech and ambulation appropriate for age should have returned to presedation levels. As with adults, patients who have received reversal agents (eg, flumazenil, naloxone) may require longer periods of observation as the half-life of the sedative may exceed that of the reversal medication and lead to resedation.

Before discharge, specific written and verbal instructions and information should be given to a parent, legal guardian, or other responsible adult. This should include signs and symptoms of potential adverse events, steps to follow in the event of an adverse event, and a phone number at which 24-hour coverage is available. Special instructions to observe the child's head position to prevent airway occlusion should be given in cases in which the child will travel in a car seat. In such cases, it may be preferable to have more than 1 adult accompany the child on the day of the procedure.

EQUIPMENT REQUIREMENTS FOR PEDIATRIC ENDOSCOPY

The technical aspects of performing upper endoscopy are essentially the same in children and adults.[97] The main difference is the smaller endoscopy equipment required to evaluate the smaller and more angulated anatomy of infants and young children. The newborn esophagus measures 8 to 10 cm in length and is approximately 5 mm in diameter. In addition, the antrum and proximal duodenum may be more angulated in young children. Although standard adult endoscopes are generally safe in children weighing more than 25 kg,[98] there are a number of commercially available endoscopes less than 6 mm in diameter with the necessary tip deflection that should be used in infants and children weighing less than 10 kg. This, as well as other pediatric endoscopy equipment, is well described in a recent ASGE technical review.[97]

The main limiting factor with all pediatric endoscopes is a 2.0-mm working channel, which is considerably smaller than the working channel in adult endoscopes.[99] The small working channel makes suctioning more difficult and limits the ability to use pediatric endoscopes for therapeutic maneuvers. Table 6 lists equipment that can fit in the single small working channel of most pediatric endoscopes. In addition, pediatric-caliber biopsy forceps with a 5-mm jaw span have been designed for use through smaller endoscopes. Although pediatric biopsy forceps generally only allow for a single biopsy specimen to be obtained, their reduced biopsy depth may be more appropriate for the thinner small-bowel and colonic mucosa of infants and young children.

TABLE 6. Equipment compatible with pediatric endoscope (2-mm channel)

Small biopsy forceps
Small polyp snare
Pediatric Roth Net
Small alligator forceps
Small rat-tooth forceps
Small injection needle
Small argon plasma coagulation probe
2-prong grasper

The technical aspects of colonoscopy are similar in adults and children, with the key difference being that the majority of pediatric colonoscopies require ileocecal intubation to screen for the diseases of interest.[5] In addition, 2 obvious differences between pediatric and adult colons are their length and diameter. In terms of the former, the colon is approximately 60 cm in length in the newborn and reaches as long as 150 cm in adults.

Adult colonoscopes (11.7-mm to 13-mm diameter) are acceptable in teenage patients approaching adult size.[97] Smaller, more flexible colonoscopes (<11.7-mm diameter) are suitable for most average-size preschool- and elementary school–age children.[100] However, despite the moniker, pediatric colonoscopes may be too large for children younger than 4 years of age.[101] Smaller neonatal endoscopes or standard adult upper endoscopes can be used for colonoscopy in infants and toddlers. Care should be taken to avoid excessive stretching of the splenic and hepatic flexures. The technical aspects of both ERCP and EUS in pediatric patients are very similar to those in adults. In turn, procedural success is defined similarly, with data suggesting that ductal cannulation in ERCP can be achieved in more than 90% of cases.[20,23,25] The major differences are in the approach to sedation and equipment available in pediatrics. Pediatric ERCP and EUS are usually performed with the patients under general anesthesia rather than moderate sedation to ensure patient safety and comfort during potentially lengthy procedures.[102]

Pediatric ERCP is primarily limited by the lack of adequate equipment intended for use in infants and young children.[97] Standard adult duodenoscopes can be used in children 2 years of age and older. Because the working channels of these endoscopes allow the passage

TABLE 7. Common hemostatic injection agents

Solution	Indications	Volumes per injection, maximum total dose
Epinephrine (1:10,000 concentration)	Bleeding ulcer	0.5- to 2-mL aliquots injected around bleeding site; max total dose of 10 mL
Ethanol (98%)	Varices	0.1- to 0.2-mL aliquots surrounding bleeding site; max total dose 0.6-1.2 mL
Sodium morrhuate 5%	Varices	0.5- to 1.0-mL aliquots, watching for effect; max total dose 5-10 mL per session
Sodium tetradecyl sulfate 1%-3%	Varices	0.5- to 1.0-mL aliquots, watching for effect; max total dose 3-5 mL per session

max, Maximum.

TABLE 8. Relative contraindications to PEG tube placement in children

Malrotation
Heterotaxy
Situs inversus
Ascites
Peritoneal dialysis catheter
Previous abdominal surgery
Hepatomegaly
Splenomegaly
Scoliosis
Ventriculoperitoneal shunt
Gastric varices

of most equipment, attempts to use standard duodenoscopes may also be appropriate, in even younger children, especially those who weigh at least 10 kg. In infants younger than 1 year of age or weighing less than 10 kg, it is generally necessary to use a 7.5-mm duodenoscope, which requires special devices to fit through the 2.0-mm working channel.

THERAPEUTIC PROCEDURES IN CHILDREN

Esophageal strictures in children are usually nonmalignant and include narrow anastomoses after surgical repair of esophageal atresia, peptic injury, eosinophilic esophagitis, congenital lesions, Schatzki's rings, achalasia, and caustic injury.[103,104] Strictures can also be found in the proximal or distal small bowel and colon related to Crohn's disease and previous surgical anastomoses.[105] Pediatric endoscopic dilation can be performed by through-the-endoscope balloon dilation or by bougienage.[103,106] Through-the-endoscope dilators are not compatible with pediatric endoscopes. In children weighing less than 10 kg, balloon dilators can be advanced under fluoroscopic guidance over a guidewire that has been placed endoscopically through the stricture.[107] The most serious adverse event associated with dilation in children is perforation, with a reported rate of 0.1% to 0.4%.[104]

Although significant GI bleeding in children is a rare event, it can be life threatening.[59] Endoscopic therapies that are available for the treatment of GI bleeding include injection, thermal coagulation, band ligation, and mechanical clipping.[108] The main limitation of using each may be the maximum size of the endoscope that can be tolerated. For example, mechanical clips are not compatible with pediatric upper endoscopes. Because of the technical limitations of performing therapeutic endoscopy for hemostasis in small children, the most common hemostatic technique is injection monotherapy.[97,108] Table 7 lists various injection agents that can be used in these clinical situations. Epinephrine in a 1:10,000 dilution is the most commonly used agent to achieve local vasoconstriction, platelet aggregation, and mechanical tamponade. Epinephrine is not tissue destructive, so relatively large volumes can be administered, even in small children. In older children who weigh at least 10 kg and who can tolerate a standard adult endoscope, band ligation has replaced sclerotherapy for the treatment of varices.[109,110] Indications for thermal coagulation with contact and noncontact devices in children include bleeding ulcers and vascular lesions.[108] Most bipolar and heater probes can only fit through a standard adult endoscope. In contrast, the noncontact thermal modality, argon plasma coagulation, has probes that are small enough to fit through the 2.0-mm working channel of the pediatric endoscope.

Pediatric gastroenterologists are increasingly playing a role in the endoscopic placement of semipermanent enteral tubes.[111,112] Indications for enteral tube placement in children include the need for supplemental calories or an inability to eat by mouth.[113] In particular, PEG tube placement has been associated with faster recovery time and less pain than open gastrostomy procedures and has become the preferred method of enteral tube placement in children.[112,114] PEG placement in children requires 2 physicians, 1 to perform the endoscopy and 1 to act as a surgical assistant. In most children who weigh less than 50 kg, a 12F or 16F PEG represents the most appropriate size for placement because smaller diameter enteral tubes with smaller "bumpers" are less likely to cause cricopharyngeal or esophageal damage during placement.

Relative contraindications to pediatric PEG placement are listed in Table 8 and include certain congenital malformations as well as patient weight less than 2 kg. Placement of PEGs in small neonates may be especially risky because of the technical need to insufflate air to distend the stomach, which may limit ventilation by impinging on the diaphragm, despite general anesthesia. Absolute contraindications to PEG placement in children include the inability to achieve successful transillumination of the stomach or to visualize finger indentation, presumably for anatomic reasons, such as the presence of an overlying liver or colon.

SUMMARY

- We recommend that endoscopy in children be performed by pediatric-trained endoscopists whenever possible. (⊕⊕⊕⊕)
- We recommend that adult-trained endoscopists coordinate their services with pediatricians and pediatric specialists when they are needed to perform endoscopic procedures in children (⊕⊕⊕⊕)
- We recommend that endoscopy be performed within 24 hours in symptomatic pediatric patients with known or suspected ingestion of caustic substances. (⊕⊕⊕○)
- We recommend emergent foreign-body removal of esophageal button batteries, as well as 2 or more rare-earth neodymium magnets. (⊕⊕⊕⊕)
- We recommend that procedural and resuscitative equipment appropriate for pediatric use should be readily available during endoscopic procedures. (⊕⊕⊕○)
- We recommend that personnel trained specifically in pediatric life support and airway management be readily available during sedated procedures in children. (⊕⊕⊕⊕)
- We recommend the use of endoscopes smaller than 6 mm in diameter in infants and children weighing less than 10 kg. (⊕⊕⊕○)
- We recommend the use of standard adult duodenoscopes for performing ERCP in children who weigh at least 10 kg. (⊕⊕⊕○)
- We recommend the placement of 12F or 16F percutaneous endoscopic gastrostomy tubes in children who weigh less than 50 kg. (⊕⊕⊕○)

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Abbreviation: AAP, American Academy of Pediatrics.

REFERENCES

1. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336:924-6.
2. Leichtner AM, Gillis LA, Gupta S, et al. NASPGHAN Guidelines for Training in Pediatric Gastroenterology. J Pediatr Gastroenterol Nutr 2013;56(Suppl 1):S1-8.
3. Hayat JO, Sirohi R, Gorard DA. Paediatric endoscopy performed by adult-service gastroenterologists. Eur J Gastroenterol Hepatol 2008;20:648-52.
4. Vandenplas Y, Rudolph CD, Di Lorenzo C, et al. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). J Pediatr Gastroenterol Nutr 2009;49:498-547.
5. Rufo PA, Denson LA, Sylvester FA, et al. Health supervision in the management of children and adolescents with IBD: NASPGHAN recommendations. J Pediatr Gastroenterol Nutr 2012;55:93-108.
6. Lee HJ, Lee JH, Lee JS, Choe YH. Is colonoscopy necessary in children suspected of having colonic polyps? Gut Liver 2010;4:326-31.
7. Thakkar K, Alsarraj A, Fong E, et al. Prevalence of colorectal polyps in pediatric colonoscopy. Dig Dis Sci 2012;57:1050-5.
8. Kori M, Gladish V, Ziv-Sokolovskaya N, et al. The significance of routine duodenal biopsies in pediatric patients undergoing upper intestinal endoscopy. J Clin Gastroenterol 2003;37:39-41.
9. Hummel TZ, ten Kate FJ, Reitsma JB, et al. Additional value of upper GI tract endoscopy in the diagnostic assessment of childhood IBD. J Pediatr Gastroenterol Nutr 2012;54:753-7.
10. Badizadegan K, Thompson KM. Value of information in nonfocal colonic biopsies. J Pediatr Gastroenterol Nutr 2011;53:679-83.
11. Volonaki E, Sebire NJ, Borrelli O, et al. Gastrointestinal endoscopy and mucosal biopsy in the first year of life: indications and outcome. J Pediatr Gastroenterol Nutr 2012;55:62-5.
12. Elitsur Y, Teitelbaum JE, Rewalt M, et al. Clinical and endoscopic data in juvenile polyposis syndrome in preadolescent children: a multicenter experience from the United States. J Clin Gastroenterol 2009;43:734-6.
13. Romero R, Abramowsky CR, Pillen T, et al. Peripheral eosinophilia and eosinophilic gastroenteritis after pediatric liver transplantation. Pediatr Transplant 2003;7:484-8.
14. Kreisel W, Dahlberg M, Bertz H, et al. Endoscopic diagnosis of acute intestinal GVHD following allogeneic hematopoietic SCT: a retrospective analysis in 175 patients. Bone Marrow Transplant 2012;47:430-8.
15. Fox V. Pediatric endoscopy. In: Classen M, Tytgat G, Lightdale CJ, editors. Gastroenterological endoscopy. New York (NY): Thieme; 2002. p. 720-48.
16. Agostoni M, Fanti L, Gemma M, et al. Adverse events during monitored anesthesia care for GI endoscopy: an 8-year experience. Gastrointest Endosc 2011;74:266-75.
17. Buderus S, Sonderkotter H, Fleischhack G, et al. Diagnostic and therapeutic endoscopy in children and adolescents with cancer. Pediatr Hematol Oncol 2012;29:450-60.
18. Gilger MA, Gold BD. Pediatric endoscopy: new information from the PEDS-CORI project. Curr Gastroenterol Rep 2005;7:234-9.

19. Samer Ammar M, Pfefferkorn MD, Croffie, et al. Complications after outpatient upper GI endoscopy in children: 30-day follow-up. Am J Gastroenterol 2003;98:1508-11.
20. Paris C, Bejjani J, Beaunoyer M, et al. Endoscopic retrograde cholangiopancreatography is useful and safe in children. J Pediatr Surg 2010;45:938-42.
21. Otto AK, Neal MD, Slivka AN, et al. An appraisal of endoscopic retrograde cholangiopancreatography (ERCP) for pancreaticobiliary disease in children: our institutional experience in 231 cases. Surg Endosc 2011;25:2536-40.
22. Barnes BH, Narkewicz MR, Sokol RJ. Spontaneous perforation of the bile duct in a toddler: the role of endoscopic retrograde cholangiopancreatography in diagnosis and therapy. J Pediatr Gastroenterol Nutr 2006;43:695-7.
23. Otto AK, Neal MD, Mazariegos GV, et al. Endoscopic retrograde cholangiopancreatography is safe and effective for the diagnosis and treatment of pancreaticobiliary disease following abdominal organ transplant in children. Pediatr Transplant 2012;16:829-34.
24. Cho S, Kamalaporn P, Kandel G, et al. 'Short' double-balloon enteroscope endoscopic retrograde cholangiopancreatography in patients with a surgically altered upper gastrointestinal tract. Can J Gastroenterol 2011;25:615-9.
25. Bang JY, Varadarajulu S. Pediatrics: ERCP in children. Nat Rev Gastroenterol Hepatol 2011;8:254-5.
26. Wu BU, Conwell DL. Update in acute pancreatitis. Curr Gastroenterol Rep 2010;12:83-90.
27. Jang JY, Yoon CH, Kim KM. Endoscopic retrograde cholangiopancreatography in pancreatic and biliary tract disease in Korean children. World J Gastroenterol 2010;16:490-5.
28. Makin E, Harrison P, Patel S, et al. Pancreatic pseudocysts in children: treatment by endoscopic cystgastrostomy. J Pediatr Gastroenterol Nutr 2012;55:556-8.
29. De Angelis P, Foschia F, Romeo E, et al. Role of endoscopic retrograde cholangiopancreatography in diagnosis and management of congenital choledochal cysts: 28 pediatric cases. J Pediatr Surg 2012;47:885-8.
30. Iqbal CW, Baron TH, Moir CR, et al. Post-ERCP pancreatitis in pediatric patients. J Pediatr Gastroenterol Nutr 2009;49:430-4.
31. Buxbaum JL, Eloubeidi MA, Varadarajulu S. Utility of EUS-guided FNA in the management of children with idiopathic fibrosing pancreatitis. J Pediatr Gastroenterol Nutr 2011;52:482-4.
32. Varadarajulu S, Wilcox CM, Eloubeidi MA. Impact of EUS in the evaluation of pancreaticobiliary disorders in children. Gastrointest Endosc 2005;62:239-44.
33. Usui N, Kamata S, Kawahara H, et al. Usefulness of endoscopic ultrasonography in the diagnosis of congenital esophageal stenosis. J Pediatr Surg 2002;37:1744-6.
34. Attila T, Adler DG, Hilden K, et al. EUS in pediatric patients. Gastrointest Endosc 2009;70:892-8.
35. Bocus P, Realdon S, Eloubeidi MA, et al. High-frequency miniprobes and 3-dimensional EUS for preoperative evaluation of the etiology of congenital esophageal stenosis in children (with video). Gastrointest Endosc 2011;74:204-7.
36. Caldaro T, Romeo E, De Angelis P, et al. Three-dimensional endoanal ultrasound and anorectal manometry in children with anorectal malformations: new discoveries. J Pediatr Surg 2012;47:956-63.
37. Rosen MJ, Moulton DE, Koyama T, et al. Endoscopic ultrasound to guide the combined medical and surgical management of pediatric perianal Crohn's disease. Inflamm Bowel Dis 2010;16:461-8.
38. Gastineau S, Viala J, Caldari D, et al. Contribution of capsule endoscopy to Peutz-Jeghers syndrome management in children. Dig Liver Dis 2012;44:839-43.
39. Gralnek IM, Cohen SA, Ephrath H, et al. Small bowel capsule endoscopy impacts diagnosis and management of pediatric inflammatory bowel disease: a prospective study. Dig Dis Sci 2012;57:465-71.
40. Cohen SA, Ephrath H, Lewis JD, et al. Pediatric capsule endoscopy: review of the small bowel and patency capsules. J Pediatr Gastroenterol Nutr 2012;54:409-13.
41. Thomson M, Fritscher-Ravens A, Mylonaki M, et al. Wireless capsule endoscopy in children: a study to assess diagnostic yield in small bowel disease in paediatric patients. J Pediatr Gastroenterol Nutr 2007;44:192-7.
42. Fritscher-Ravens A, Cuming T, Jacobsen B, et al. Feasibility and safety of endoscopic full-thickness esophageal wall resection and defect closure: a prospective long-term survival animal study. Gastrointest Endosc 2009;69:1314-20.
43. Barth BA, Donovan K, Fox VL. Endoscopic placement of the capsule endoscope in children. Gastrointest Endosc 2004;60:818-21.
44. Shen R, Sun B, Gong B, et al. Double-balloon enteroscopy in the evaluation of small bowel disorders in pediatric patients. Dig Endosc 2012;24:87-92.
45. Uchida K, Yoshiyama S, Inoue M, et al. Double balloon enteroscopy for pediatric inflammatory bowel disease. Pediatr Int 2012:806-9.
46. Di Nardo G, de Ridder L, Oliva S, et al. Enteroscopy in paediatric Crohn's disease. Dig Liver Dis 2013;45:351-5.
47. Soccorso G, Sarkhy A, Lindley RM, et al. Idiopathic small bowel diaphragm disease identified by laparoscopic-assisted double-balloon enteroscopy in a child: an integrated successful definitive therapeutic method. J Pediatr Surg 2012;47:1622-5.
48. Ikenberry SO, Jue TL, Anderson MA, et al. Management of ingested foreign bodies and food impactions. Gastrointest Endosc 2011;73:1085-91.
49. Litovitz T, Whitaker N, Clark L, et al. Emerging battery-ingestion hazard: clinical implications. Pediatrics 2010;125:1168-77.
50. Brumbaugh DE, Colson SB, Sandoval JA, et al. Management of button battery-induced hemorrhage in children. J Pediatr Gastroenterol Nutr 2011;52:585-9.
51. George AT, Motiwale S. Magnet ingestion in children–a potentially sticky issue? Lancet 2012;379:2341-2.
52. Otjen JP, Rohrmann CA Jr, Iyer RS. Imaging pediatric magnet ingestion with surgical-pathological correlation. Pediatr Radiol 2013;43:851-9.
53. Hussain SZ, Bousvaros A, Gilger M, et al. Management of ingested magnets in children. J Pediatr Gastroenterol Nutr 2012;55:239-42.
54. Wilsey MJ Jr, Scheimann AO, Gilger MA. The role of upper gastrointestinal endoscopy in the diagnosis and treatment of caustic ingestion, esophageal strictures, and achalasia in children. Gastrointest Endosc Clin N Am 2001;11:767-87, vii-viii.
55. Gupta SK, Croffie JM, Fitzgerald JF. Is esophagogastroduodenoscopy necessary in all caustic ingestions? J Pediatr Gastroenterol Nutr 2001;32:50-3.
56. American Association of Poison Control Centers American Association of Poison Control Centers 2013. Available at http://www.aapcc.org. Accessed January 8, 2013.
57. Temiz A, Oguzkurt P, Ezer SS, et al. Predictability of outcome of caustic ingestion by esophagogastroduodenoscopy in children. World J Gastroenterol 2012;18:1098-1103.
58. Lamireau T, Rebouissoux L, Denis D, et al. Accidental caustic ingestion in children: is endoscopy always mandatory? J Pediatr Gastroenterol Nutr 2001;33:81-4.
59. Poley JW, Steyerberg EW, Kuipers EJ, et al. Ingestion of acid and alkaline agents: outcome and prognostic value of early upper endoscopy. Gastrointest Endosc 2004;60:372-7.
60. Baskin D, Urganci N, Abbasoglu L, et al. A standardised protocol for the acute management of corrosive ingestion in children. Pediatr Surg Int 2004;20:824-8.
61. Tiryaki T, Livanelioglu Z, Atayurt H. Early bougienage for relief of stricture formation following caustic esophageal burns. Pediatr Surg Int 2005;21:78-80.
62. Mahajan L, Wyllie R, Steffen R, et al. The effects of a psychological preparation program on anxiety in children and adolescents undergoing gastrointestinal endoscopy. J Pediatr Gastroenterol Nutr 1998;27:161-5.
63. Friedlander JA, Loeben GS, Finnegan PK, et al. A novel method to enhance informed consent: a prospective and randomised trial of form-based versus electronic assisted informed consent in paediatric endoscopy. J Med Ethics 2011;37:194-200.

64. Cote CJ, Wilson S. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update. Pediatrics 2006;118:2587-602.
65. Hoffman GM, Nowakowski R, Troshynski TJ, et al. Risk reduction in pediatric procedural sedation by application of an American Academy of Pediatrics/American Society of Anesthesiologists process model. Pediatrics 2002;109:236-43.
66. Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation 2007;116:1736-54.
67. Di Filippo S. Prophylaxis of infective endocarditis in patients with congenital heart disease in the context of recent modified guidelines. Arch Cardiovasc Dis 2012;105:454-60.
68. Cook-Sather SD, Litman RS. Modern fasting guidelines in children. Best Pract Res Clin Anaesthesiol 2006;20:471-81.
69. Hunter A, Mamula P. Bowel preparation for pediatric colonoscopy procedures. J Pediatr Gastroenterol Nutr 2010;51:254-61.
70. Turner D, Benchimol EI, Dunn H, et al. Pico-Salax versus polyethylene glycol for bowel cleanout before colonoscopy in children: a randomized controlled trial. Endoscopy 2009;41:1038-45.
71. Phatak UP, Johnson S, Husain SZ, et al. Two-day bowel preparation with polyethylene glycol 3350 and bisacodyl: a new, safe, and effective regimen for colonoscopy in children. J Pediatr Gastroenterol Nutr 2011;53:71-4.
72. Abbas MI, Nylund CM, Bruch CJ, et al. Prospective evaluation of 1-day polyethylene glycol-3350 bowel preparation regimen in children. J Pediatr Gastroenterol Nutr 2013;56:220-4.
73. Jibaly R, LaChance J, Lecea NA, et al. The utility of PEG3350 without electrolytes for 2-day colonoscopy preparation in children. Eur J Pediatr Surg 2011;21:318-21.
74. Terry NA, Chen-Lim ML, Ely E, et al. Polyethylene glycol powder solution vs. senna for bowel preparation for colonoscopy in children: a prospective, randomized, investigator-blinded trial. J Pediatr Gastroenterol Nutr 2013;56:215-9.
75. Jimenez-Rivera C, Haas D, Boland M, et al. Comparison of two common outpatient preparations for colonoscopy in children and youth. Gastroenterol Res Pract 2009;2009:518932.
76. Turner D, Levine A, Weiss B, et al. Evidence-based recommendations for bowel cleansing before colonoscopy in children: a report from a national working group. Endoscopy 2010;42:1063-70.
77. Wexner SD, Beck DE, Baron TH, et al. A consensus document on bowel preparation before colonoscopy: prepared by a task force from the American Society of Colon and Rectal Surgeons (ASCRS), the American Society for Gastrointestinal Endoscopy (ASGE), and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). Gastrointest Endosc 2006;63:894-909.
78. Hassall E, Lobe TE. Risks of oral sodium phosphate for pre-colonoscopy bowel preparation in children. Dis Colon Rectum 2007;50:1099-101, author reply 102–3.
79. Wexner SD, Rosen L, Baron TH. Risks of oral sodium phosphate for pre-colonoscopy bowel preparation in children: response to Drs. Hassall and Lobe. Surg Endosc 2007;21:1040-1.
80. Pashankar DS, Uc A, Bishop WP. Polyethylene glycol 3350 without electrolytes: a new safe, effective, and palatable bowel preparation for colonoscopy in children. J Pediatr 2004;144:358-62.
81. Safder S, Demintieva Y, Rewalt M, et al. Stool consistency and stool frequency are excellent clinical markers for adequate colon preparation after polyethylene glycol 3350 cleansing protocol: a prospective clinical study in children. Gastrointest Endosc 2008;68:1131-5.
82. Adamiak T, Altaf M, Jensen MK, et al. One-day bowel preparation with polyethylene glycol 3350: an effective regimen for colonoscopy in children. Gastrointest Endosc 2010;71:573-7.
83. Fredette ME, Lightdale JR. Endoscopic sedation in pediatric practice. Gastrointest Endosc Clin N Am 2008;18:739-51.
84. van Beek EJ, Leroy PL. Safe and effective procedural sedation for gastrointestinal endoscopy in children. J Pediatr Gastroenterol Nutr 2012;54:171-85.
85. Lewis Claar R, Walker LS, Barnard JA. Children's knowledge, anticipatory anxiety, procedural distress, and recall of esophagogastroduodenoscopy. J Pediatr Gastroenterol Nutr 2002;34:68-72.
86. Liacouras CA, Mascarenhas M, Poon C, et al. Placebo-controlled trial assessing the use of oral midazolam as a premedication to conscious sedation for pediatric endoscopy. Gastrointest Endosc 1998;47:455-60.
87. Paspatis GA, Charoniti I, Manolaraki M, et al. Synergistic sedation with oral midazolam as a premedication and intravenous propofol versus intravenous propofol alone in upper gastrointestinal endoscopies in children: a prospective, randomized study. J Pediatr Gastroenterol Nutr 2006;43:195-9.
88. Fishbein M, Lugo RA, Woodland J, et al. Evaluation of intranasal midazolam in children undergoing esophagogastroduodenoscopy. J Pediatr Gastroenterol Nutr 1997;25:261-6.
89. Thakkar K, El-Serag HB, Mattek N, et al. Complications of pediatric EGD: a 4-year experience in PEDS-CORI. Gastrointest Endosc 2007;65:213-21.
90. Tait AR, Malviya S. Anesthesia for the child with an upper respiratory tract infection: still a dilemma? Anesth Analg 2005;100:59-65.
91. Lightdale JR, Goldmann DA, Feldman HA, et al. Microstream capnography improves patient monitoring during moderate sedation: a randomized, controlled trial. Pediatrics 2006;117:1170-8.
92. Gilger MA, Jeiven SD, Barrish JO, et al. Oxygen desaturation and cardiac arrhythmias in children during esophagogastroduodenoscopy using conscious sedation. Gastrointest Endosc 1993;39:392-5.
93. Lightdale JR, Valim C, Mahoney LB, et al. Agitation during procedural sedation and analgesia in children. Clin Pediatr (Phila) 2010;49:35-42.
94. Schwarz SM, Lightdale JR, Liacouras CA. Sedation and anesthesia in pediatric endoscopy: one size does not fit all. J Pediatr Gastroenterol Nutr 2007;44:295-7.
95. Vargo JJ, Delegge MH, Feld AD, et al. Multisociety sedation curriculum for gastrointestinal endoscopy. Gastrointest Endosc 2012;76:e1-e25.
96. Wengrower D, Gozal D, Gozal Y, et al. Complicated endoscopic pediatric procedures using deep sedation and general anesthesia are safe in the endoscopy suite. Scand J Gastroenterol 2004;39:283-6.
97. Barth BA, Banerjee S, Bhat YM, et al. Equipment for pediatric endoscopy. Gastrointest Endosc 2012;76:8-17.
98. Benaroch LM, Rudolph CD. Introduction to pediatric esophagogastroduodenoscopy and enteroscopy. Gastrointest Endosc Clin N Am 1994;4:121-42.
99. Rodriguez SA, Banerjee S, Desilets D, et al. Ultrathin endoscopes. Gastrointest Endosc 2010;71:893-8.
100. Wyllie R, Kay MH. Colonoscopy and therapeutic intervention in infants and children. Gastrointest Endosc Clin N Am 1994;4:143-60.
101. Thomson M. Colonoscopy and enteroscopy. Gastrointest Endosc Clin N Am 2001;11:603-39, vi.
102. Garewal D, Powell S, Milan SJ, et al. Sedative techniques for endoscopic retrograde cholangiopancreatography. Cochrane Database Syst Rev 2012;6:CD007274.
103. Best C, Sudel B, Foker JE, et al. Esophageal stenting in children: indications, application, effectiveness, and complications. Gastrointest Endosc 2009;70:1248-53.
104. Pearson EG, Downey EC, Barnhart DC, et al. Reflux esophageal stricture–a review of 30 years' experience in children. J Pediatr Surg 2010;45:2356-60.
105. de Bie CI, Paerregaard A, Kolacek S, et al. Disease phenotype at diagnosis in pediatric Crohn's disease: 5-year analyses of the EUROKIDS registry. Inflamm Bowel Dis 2013;19:378-85.
106. Lakhdar-Idrissi M, Khabbache K, Hida M. Esophageal endoscopic dilations. J Pediatr Gastroenterol Nutr 2012;54:744-7.

107. Spiliopoulos S, Sabharwal T, Krokidis M, et al. Fluoroscopically guided dilation of esophageal strictures in patients with dystrophic epidermolysis bullosa: long-term results. AJR Am J Roentgenol 2012;199:208-12.
108. Kay MH, Wyllie R. Therapeutic endoscopy for nonvariceal gastrointestinal bleeding. J Pediatr Gastroenterol Nutr 2007;45:157-71.
109. Zargar SA, Javid G, Khan BA, et al. Endoscopic ligation compared with sclerotherapy for bleeding esophageal varices in children with extrahepatic portal venous obstruction. Hepatology 2002;36:666-72.
110. Bandika VL, Goddard EA, De Lacey RD, et al. Endoscopic injection sclerotherapy for bleeding varices in children with intrahepatic and extrahepatic portal venous obstruction: benefit of injection tract embolisation. S Afr Med J 2012;102:884-7.
111. Avitsland TL, Kristensen C, Emblem R, et al. Percutaneous endoscopic gastrostomy in children: a safe technique with major symptom relief and high parental satisfaction. J Pediatr Gastroenterol Nutr 2006;43:624-8.
112. Fortunato JE, Troy AL, Cuffari C, et al. Outcome after percutaneous endoscopic gastrostomy in children and young adults. J Pediatr Gastroenterol Nutr 2010;50:390-3.
113. Srinivasan R, Irvine T, Dalzell M. Indications for percutaneous endoscopic gastrostomy and procedure-related outcome. J Pediatr Gastroenterol Nutr 2009;49:584-8.
114. McSweeney ME, Jiang H, Deutsch AJ, et al. Long-term outcomes of infants and children undergoing Percutaneous Endoscopic Gastrostomy (PEG) tube placement. J Pediatr Gastroenterol Nutr. Epub 2013 Jun 15.

Prepared by:
ASGE STANDARDS OF PRACTICE COMMITTEE
Jenifer R. Lightdale, MD, MPH
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