Endoscopy in Pediatric Inflammatory Bowel Disease

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Foreword

Since its introduction in the late 1960s, the field of pediatric gastroenterology and endoscopy has developed rapidly. During the last 30 years, the number of pediatric gastroenterologists performing endoscopic procedures has progressively increased with pediatric endoscopy evolving from an infrequent procedure in the operating room to a routine outpatient procedure. The rapid growth and standardization of endoscopic procedures in children has been associated with an improvement of diagnosis and management of pediatric population with IBD. With approximately 25% of IBDs presenting before the patient is 20 years of age, pediatric endoscopy has become an integral part of a diagnostic process in a significant number of young IBD patients. Presentations in the pediatric population may differ from those typically seen in adults. Unique features in children may include growth failure and pubertal delay, which must be considered when planning treatment. Moreover, clear diagnosis of IBD and differentiation of CD from UC and/or IC are essential for pediatric patients in planning the optimal treatment strategy in a given patient. This is why endoscopy in this subset of population is very peculiar and requires dedicated skills and specific approaches which somehow may differ from those routinely used in adult IBD patients. Recommendations from the European and North American pediatric gastroenterology societies have helped to bring uniformity in the diagnostic work-up and the differentiation of IBD types. Nonetheless, a lot remains to be done to upgrade and standardize practice of pediatric endoscopy in the management of IBD populations. For the new generation of pediatric endoscopists, the challenge will be to properly use invasive endoscopic tests in association with noninvasive diagnostic tools like wireless capsule or fecal calprotectin. This makes imperative that gastroenterologists managing pediatric patients with IBD have a specific training path and develop extensive expertise for advanced diagnostic modalities including endoscopy of the small bowel such as enteroscopy. I am very pleased to introduce this very comprehensive and updated book dealing with the different topics of pediatric endoscopy in the field of IBD conditions. Every single chapter has been developed to provide the most extensive and practical guide to perform endoscopy according to the most recent guideline. All different aspects of IBD endoscopy are nicely discussed with a clinical approach where endoscopy is integrated as part of the instrumental and clinical framework required to provide early diagnosis and to guide therapy. The book reads really well and may represent a useful tool also for those pediatric gastroenterologists who are developing their

training in endoscopy and have to quickly find the resources and the information to implement their endoscopic procedures in children with IBD. I do believe that the authors should be congratulated for this excellent piece of work, which will remain as one of the best available educational books for those who need an updated and extensive guide to support their practice in endoscopy for pediatric patients diagnosed with inflammatory conditions of the GI tract.

Milan, Italy Alessandro Repici

Preface

Endoscopy can be considered an essential part of proper care in children with inflammatory bowel diseases (IBDs), including ulcerative colitis (UC) and Crohn's disease (CD). The role ranges widely from diagnosing the disease to assessing the extent of the disease and its activity. Major advances in recent years, with the emergence of new techniques such as wireless video capsule endoscopy (WCE), device-assisted enteroscopy (DAE), chromoendoscopy, and confocal endomicroscopy, have been achieved. In pediatric population, endoscopy has a major role in the differential diagnosis of the IBD, between CD and UC or indeterminate colitis. The techniques of sedation allow the execution of the exams with better safety. Endoscopic reassessment is considered in cases of frequent relapses, refractoriness, surgery, and in monitoring biological therapies response. The role of endoscopy in IBD is to assist in the diagnosis of IBD disease activity, in defines disease distribution/extent and assessment of treatment success (mucosal healing). Recently, new guidelines for endoscopy in IBD were published by the European Crohn's and Colitis Organization, but few details are available for pediatric specificity. In this book, we have summarized the main topics of endoscopy in pediatric inflammatory bowel disease as equipment in pediatric endoscopy, patient and parents preparation, sedation, endoscopic features in early onset IBD, esophagogastroduodenoscopy and ileocolonoscopy, application of the endoscopic scores, small bowel endoscopy, endoscopic intervention in IBD, and cancer and dysplasia surveillance. The selected authors have maximum competence in this field, and this book can be an important aid in clinical practice and in the management of children with IBD. We confirm that endoscopy is an important tool in the diagnosis and management of IBD, but the sensitivity and specificity are increased if this technique is used by expert hands and with proper interpretation of the results.

Messina, Italy — Claudio Romano

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Maria Teresa Illiceto, Gabriele Lisi, and Giuliano Lombardi

1.1 Introduction

The endoscopic techniques used in children are quite similar to those used in the adult. The anatomical differences, especially in children below 10–15 kg of body weight, condition the endoscopist while choosing the instrument:

- the newborn's esophagus measures 8–10 cm in length and approximately 5 mm in diameter, and the soft posterior wall of the trachea is easily compressed during upper endoscopy.
- in small children, the antrum is acutely angulated, requiring a greater degree of tip deflection to view the pylorus.
- in the same way, the proximal duodenum is angulated, obscuring views of the posteromedial wall [1].
- the diameter of the empty duodenum, jejunum, and ileum in newborns measure 10–15 mm.
- the neonatal colonic diameter is approximately 10 mm except for the cecum, that is approximately 17 mm.

An additional limitation to the choice of endoscopes diameter is the compression of the trachea with an endotracheal tube inside. Current technology permits safe visualization, tissue sampling, and therapeutic interventions of the upper and lower

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Table 1.1 Endoscope choice based on weight (ESGE-ESPGHAN guidelines)

Weight or age	EGD	Colonoscopy	ERCP
<10 kg or <1 year	≤6 mm gastroscope preferred. Consider standard adult gastroscope if endotherapy required	≤6 mm gastroscope, standard adult gastroscope or pediatric colonoscope.	7.5 mm duodenoscope
≥10 kg or >1 year	Standard adult gastroscope Therapeutic gastroscope if needed	Pediatric or adult colonoscope	Therapeutic duodenoscope (4.2 mm operative channel)

gastrointestinal tracts in even preterm newborns. Over the years several guidelines have been published, regarding the type of endoscopes to be used; we refer to the most recent ESGE-ESPGHAN guidelines (Table 1.1).

The three major manufacturers (Olympus, Fujinon, and Pentax) have pediatric product lines with similar characteristics. Each provides brilliant, high-resolution color views of the gastrointestinal mucosa through a wide angle. The depth of view ranges from 5 to 100 mm, with nearly a 30-fold magnification of the mucosa. Depending on the manufacturer, smaller-sized duodenoscopes, enteroscopes, and variable-stiffness colonoscopes can be found. In addition, adult operative (two-channel) gastroscopes and "zoom" gastroscopes allowing magnification (up to 150×) of the mucosal image have occasional applications in children.

In 2012, the American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee drew up reviews of existing, new, or emerging endoscopic technologies that have an impact on the practice of gastrointestinal (GI) endoscopy [2]. More recently, in 2017, the European Society of Gastrointestinal Endoscopy (ESGE) and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) published the executive summary of the Guidelines on pediatric gastrointestinal endoscopy that refers to infants, children, and adolescents aged 0–18 years.

1.1.1 Esophagogastroduodenoscopy (EGD)

The choice of pediatric endoscope type is based on the age and weight of the patient, the presence of any anatomical anomalies, and the indication for the procedure (diagnostic and/or therapeutic) (Table 1.2) [2].

1.1.2 Neonatal Patients

Neonatal (ultrathin) gastroscopes are similar to standard gastroscopes in design and length, but some models have only two-way tip deflection (up/down) [3], and right/left view is obtained by rotating the shaft of the instrument. The smallest insertion tube diameter allows easy transit through the narrow pediatric lumens. Also the

Table 1.2 Neonatal (ultrathin) and pediatric gastroscopes (ASGE Technology Committee, 2012)

Manufacturer	Model	Insertion tube length/diameter, mm	Definition/magnification/color enhancement	Biopsy channel/diameter, mm
Olympus	GIF-N180	1100/4.9	Standard/none/NBI	1/2.0
	GIF-XP180N	1100/5.5	Standard/none/NBI	1/2.0
Fujinon	EG530N	1100/5.9	High-definition/zoom	1/2.0
	EG530NP	1100/4.9	High-definition/zoom	1/2.0
Pentax	EG1690K	1100/5.4	Standard/zoom/iSCAN	1/2.0
	EG1870K	1050/6.0	Standard/zoom/iSCAN	1/2.0

NBI narrow-band imaging

working channel of these endoscopes is narrower (1.5–2.0 mm), requiring the use of appropriate small-caliber accessories. Due to the small diameter of the working channel the suction capacity in case of bleeding is inadequate, so in these cases the use of a larger caliber endoscope is indicated.

1.1.3 Children Weighing less than 10–15 kg

In patients weighing less than 10–15 kg, gastroscopes with an outer diameter of 4.9–6.0 mm are preferred, particularly for those weighing less than 5 kg [4, 5]. In these patients, the use of larger diameter gastroscopes (both for diagnostic and therapeutic procedures) exhibits a high risk of mucosal damage, perforation, and tracheal compression.

1.1.4 Children Older than 12 Months or Weighing more than 10–15 kg

In most children older than 1 year and weighing more than 10–15 kg, gastroscopes with an outside diameter of 8 mm or larger may be used. However, most pediatric endoscopists start the examination with a smaller gastroscope, and eventually proceed with a larger caliber if the procedure requires it (bleeding, dilatation, …), compatibly with the ability of the instrument to pass beyond the physiological anatomic narrowings (upper esophageal sphincter, pylorus).

1.2 Colonoscopy

Pediatric colonoscopy is an instrumental test that is extremely useful in selected cases, but has specific peculiarities compared to adulthood, both for indications and for procedures.

The American Society for Gastrointestinal Endoscopy (ASGE) and the North American Society for Pediatric Gastroenterology Hepatology and Nutrition

Table 1.3 Typical diagnostic and therapeutic indications, non-indications, and contraindications for ileocolonoscopy in pediatric patients (ESGE-ESPGHAN 2017)

Diagnostic indications
Unexplained anemia
Unexplained chronic diarrhea
Perianal lesions (fistula, abscess)
Rectal blood loss
Unexplained failure to thrive
Suspicion of graft-versus-host disease
Rejection or complications after intestinal transplantation Polyposis syndrome (diagnosis and surveillance)
Radiological suspicion of ileocolonic stenosis/stricture
Polyposis syndromes
Therapeutic indications
Polypectomy
Foreign-body removal
Dilation of ileocolonic stenosis
Treatment of hemorrhagic lesions
Reduction of sigmoidal volvulus
Non-indications
Functional GI disorders
Constipation
Contraindications
Toxic megacolon
Recent colonic perforation
Recent intestinal resection (<7 days)

(NASPGHAN) modified the previous guidelines, adding clear indications for pediatric endoscopy [6]. The ESGE-ESPGHAN guidelines revised the indications, both in terms of diagnosis and treatment (Table 1.3).

Pediatric colonoscopes have variable insertion tube lengths (1330–1700 mm), shaft diameters (9.8–11.8 mm), and channel size (2.8–3.8 mm) (Table 1.4).

There are no published data to support specific guidelines for a colonoscopes caliber in children, and recommendations are based on experience.

1.2.1 Neonatal Patients (<5 kg)

Children weighing less than 5 kg may undergo successful ileocolonoscopy with ultrathin gastroscopes, although the procedure may be difficult due to the flexibility of the insertion tube.

1.2.2 Children Weighing Between 5 and 12 kg

In children weighing between 5 and 12 kg, colonoscopy can be performed using a pediatric or adult standard gastroscope.

Table 1.4 Pediatric colonoscopies (ASGE Technology Committee, 2012)

Manufacturer	Model	Insertion tube length/diameter, mm	Definition/magnification/ color enhancement	Biopsy channel number/ diameter, mm
Olympus	PCF Q180 AL	1680/11.5	High resolution/none/NBI	1/3.2
	PCF Q180 AI	1330/11.5	High resolution/none/NBI	1/3.2
	PCF H180 AL	1680/11.8	High resolution/none/NBI	1/3.2
	PCF H180 AI	1330/11.8	High resolution/none/NBI	1/3.2
Fujinon	EC530 LS	1690/11.5	High-definition/zoom	1/3.8
	EC450 LS5	1690/11.5	High-definition/zoom	1/3.8
	EC450 LPS	1690/11.1	High-definition/zoom	1/3.2
Pentax	EC2990 Li	1700/9.8	High-definition/zoom/ iSCAN	1/2.8
	EC3490 Li	1700/11.6	High-definition/zoom/ iSCAN	1/3.2
	EC3490 LK	1700/11.6	High resolution/zoom/ iSCAN	1/3.8

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1.2.3 Children Weighing more than 12–15 kg

A body weight of 12–15 kg represents the limit for the use of a standard pediatric colonoscopy [7].

The limitation of procedures carried out with a pediatric colonoscope with a 2.8-mm working channel is the impossibility to use larger accessories.

1.3 Capsule Endoscopy

Clinical use of the capsule endoscopy (CE) received the approval of the FDA in 2001, and it shortly became a modern approach in the exploration of the intestine, although, only recently, data on its application in pediatric gastroenterology are emerging [8]. In 2015, a review provides an up-to-date information about wireless capsule endoscopy in children, in the contest of a Journal Continuing-Medical-Education (CME) Activity by NASPGHAN [9].

Indications for CE in children provide evaluation of the small bowel mucosa in Crohn's disease, occult bleeding, polyposis, graft-versus-host disease, lymphangiectasia, growth failure, or abdominal pain [10–13].

This procedure is approved by the U.S. Food and Drug Administration for children 2 years old or older, but there are no guidelines on the lower age and weight limits (few cases are described of 8–10 months old infant in which the procedure was successfully performed) [14, 15].

The main problem for the procedure in children is their ability to swallow the capsule, which measures 11 × 26 mm. In patients who are either unable to swallow the capsule by age (below 4 years [13]), by refusal or fear (even in older children), or by anatomical abnormalities, the capsule can be placed directly in the stomach or

duodenum with a trans-endoscopic delivery device of 2.5 mm in diameter, which requires the use of an endoscope working channel ≥2.8 mm.

CE has been performed safely in a small series of pediatric patients, always confirming its degree of safety and tolerability. In addition, several studies have reported greater sensitivity than radiological and standard endoscopic examination in the detection of small bowel Crohn's disease distribution, gastrointestinal bleeding source, and presence of polyps in children [16]. The limitation of capsule endoscopy is the inability to biopsy and treat small bowel lesions. Colon capsule endoscopy (CCE) is a minimally invasive technique specifically designed to explore the colon without sedation and air insufflation. This procedure has been assessed as a surrogate to colonoscopy in pediatric ulcerative colitis [17].

1.3.1 Small Bowel Enteroscopy

Endoscopic investigation of small bowel disorders in children has historically been difficult due to the length and tortuosity of the organ itself [18]. Factors influencing the choice of endoscope are similar to those listed for upper endoscopy. Performing an enteroscopy may be more difficult in children because of the smaller abdominal cavity.

1.3.2 Push Enteroscopy

Push enteroscopy can be performed using an enteroscope or pediatric colonoscope. Enteroscopes are available with an outer diameter of 8.5–11.6 mm, working lengths of 2000–2200 mm, and a channel size of 2.2–3.8 mm.

1.3.3 Antegrade and Retrograde Balloon-Assisted Enteroscopy

The introduction of balloon enteroscopy allows deep intubation of the small bowel, and at times viewing of the entire mucosal surface.

– *Double-Balloon enteroscopy* has been safely reported in children as small as 12 kg and youngest age 2 years, and has been successfully performed in children with Roux-en-Y anastomoses in the evaluation and therapy of biliary strictures. We must consider that procedures performed in children under 8–10 years of age present a greater risk of complications [19].

Double-balloon enteroscopes (Fujinon, Wayne, NJ) consist of a high-resolution video enteroscope (EN-450P5/20) with a flexible overtube (TS-12140), having working lengths of 1520–2000 mm, outer diameter of 8.5–9.4 mm, and channel size of 2.2–2.8 mm. The overtubes require measure 12.2–13.2 mm in outer diameter. The enteroscopes and overtube have balloons fitted at the distal tip of each, which

are sequentially inflated and deflated with air from a pressure controlled pump system with a maximum inflatable pressure of 45 mmHg. Available devices include argon plasma coagulation probes, biopsy forceps, and polypectomy snares. Training and learning curves for this procedure are, it is estimated by the procedurists, similar to that encountered in ileocolonoscopy, and clearly it is not yet apparent in pediatric practice how many DBE procedures are necessary in order to attain a high degree of competence [20].

– *Single-balloon enteroscopy* has also been performed in pediatric children [21, 22], the smallest of which reported undergone an antegrade study was 3 years old and weighed 13.5 kg [23].

One single-balloon enteroscope system is available (Olympus Medical System) with a 9.2 mm outer diameter, a working length of 2000 mm and a 2.8-mm channel, with an overtube of 13.2 mm outer diameter.

Both procedures can be applied to patients who tolerate the diameter of the overtube.

1.4 Endoscopic Retrograde Cholangiopancreatography (ERCP)

The ERCP can be performed successfully and safely in children with complication rates comparable to those in adults. The type of cannulation and patient age are independent risk factors for complications [23].

The ESGE/ESPGHAN guidelines indicate ERCP in pediatric patients (>1 year old) for therapeutic purposes (chronic pancreatitis, recurrent acute pancreatitis, pancreas divisum, postsurgical/post-traumatic pancreatic duct leak, pancreatic pseudocyst, common bile duct stones, postsurgical/post-traumatic bile leak, benign and/or malignant biliary strictures, primary sclerosing cholangitis often associated with inflammatory bowel disease, parasitosis) following diagnostic information from noninvasive modalities, while diagnostic ERCP can be considered in selected cases (evaluation of anomalous biliopancreatic junction, cholestasis in neonates and infants, choledochal cyst, and primary sclerosing cholangitis), performing the procedure with a pediatric 7.5-mm duodenoscope (2-mm working channel) in children weighing <10 kg, using a therapeutic duodenoscope (10.8–12.1 mm outer diameter) in those weighing ≥10 kg (although the soft-walled trachea in young children may become compressed because of the large diameter) [24, 25].

1.4.1 Endoscopic Ultrasonography (EUS)

The application of endoscopic ultrasound (EUS) in children is growing, with studies demonstrating a positive impact of EUS in the management of childhood diseases.

EUS has shown to be useful in the evaluation and management of a spectrum of childhood diseases including pancreaticobiliary disease, congenital anomalies, submucosal lesions, biliary stones disease, inflammatory bowel disease, and eosinophilic esophagitis. Its diagnostic capabilities with fine-needle aspiration and core-needle biopsy are shown to be technically successful, safe, and effective in several pediatric studies. Therapeutic EUS procedures include endoscopic cystgastrostomy, celiac plexus neurolysis, and biliary access [26–28]. There are no specific equipment for children. Standard radial echoendoscopes have a tip diameter ranging from 12.7 to 14.2 mm, and linear FNA echoendoscopes are slightly larger, measuring 12.1–14.6 mm in tip diameter.

In children weighing >15 kg a standard echo-endoscope should be employed only under general anesthesia, considering the stiff and potentially traumatic rigid distal part, requiring strict collaboration between adult and pediatric gastroenterologists [25].

The endobronchial ultrasound (EBUS) endoscope can be adapted for EUS in children with a weight below 15 kg.

Through-the-scope miniprobes with frequencies ranging from 12 to 30 MHz may be used through a 2.8-mm working channel of a standard gastroscope, in infant as young as 5 months of age. In smaller infants, a 1.7-mm miniprobe is available.

1.4.2 Biopsy Forceps

Mucosal biopsies are an essential component of most pediatric endoscopic procedures. Forceps available for 2-mm channel have fenestrated and serrated designs, with and without a needle-spike and with oval or alligator-type cups.

Large-cup forceps have been used in children without complications, but the utility of a larger tissue specimen is uncertain in pediatric population.

1.4.3 Endoscopic Retrieval Devices

To remove foreign bodies, there are several devices compatible with 2-mm working channels, such as retrieval snares, retrieval nets, alligator jaw, rat-tooth, and 3-prong graspers, as well as baskets [29]. There are no published data on the use of overtubes in children, because it is rarely used due to the high risk of injury to the esophagus or pharynx.

1.4.4 Polypectomy Devices

Most children requiring a polypectomy have an age and weight that allows using probes with a 2.8-mm working channel, but there are also polypectomy snares for use through a 2.0-mm channel.

1.4.5 Hemostatic Devices

Pediatric hemostasis techniques do not differ from those of the adult, and include: injection therapy, mechanical closure, and thermal techniques (multipolar/bipolar electrocautery, heater probe, and argon plasma coagulation).

In the last few years, hemostatic powders have been introduced for the endoscopic management of hemorrhagic lesions, either venous or arterial, and treatment of bleeding from malignant masses in adult patients [30–34].

1.4.6 Devices for Esophageal and Ileocolonic Dilation

Dilation of esophageal strictures in pediatric patients has been performed for decades [35]. Endoscopic dilators and techniques have been reported and depend on the stricture's etiology, the availability of different tools, and the operator's experience and preferences (Fig. 1.1).

At the beginning, the only dilators available were the Maloney dilators, which were passed under guidance of the rigid esophagoscope or blindly.

As soon as balloons and the Savary-Gilliard (S-G) dilators became available, blind bougienage was abandoned [36].

Balloon and semirigid dilators are the most frequently used tools. No high-quality studies have reported on the differences in the efficacies and rates of complications associated with these two types of dilators.

In patients with Crohn's disease (CD), strictures typically are found in terminal ileum and colon as well as the site of ileocolonic surgical anastomosis. Endoscopic balloon dilation in patients with symptomatic CD strictures of the small bowel has a durable clinical response. Two retrospective series found technical success rates of 89–97%, and serious adverse events were reported in 5%. Dilating balloons >20 mm appear to be associated with more adverse events [37].

1.4.6.1 Bougie Dilators

Bougie dilators can be passed across esophageal strictures by applying axial and radial force to the narrowed region.

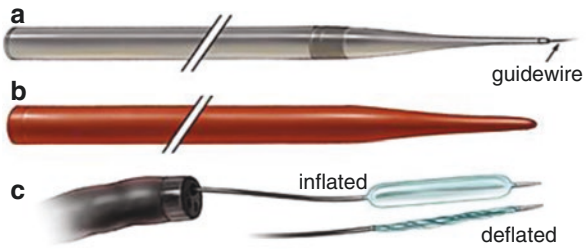

Fig. 1.1 Esophageal dilators: (**a**) Savary, (**b**) Maloney, (**c**) Through-the-scope (TTS) balloon catheter

– Available bougie dilators include Savary-Gilliard (Cook Endoscopy), which are tapered with a radiopaque marker at the base of the taper. These polyvinyl wire-guided dilators have various diameters (5–20 mm or 15F–60F) and lengths (70 or 100 cm). They are safer and more effective than balloon dilators in the treatment of consolidated and old cicatricial strictures and in cases of resistant esophageal narrowing due to, e.g., congenital esophageal stenosis (CES) with cartilaginous remnants [38].
– American Dilation System dilators are similar but have a shorter taper tip and are radiopaque throughout their length.
– Tucker dilators are especially useful in the treatment of tortuous strictures secondary to caustic ingestions [39]. These are small silicone bougies, tapered at each end with loops that can be pulled antegrade or retrograde across very tight strictures regardless of length. A gastrostomy is required for use. In very tight strictures where there is the possibility of complete lumen occlusion, a string must be maintained across the stricture emerging from both the nose and gastrostomy site between dilations. Tucker dilators range in size from 4 to 13.3 mm (12F–40F).

1.4.6.2 Through-the-Scope Balloon

Balloon dilation can be performed in infants who will not tolerate a standard gastroscope by using a guidewire and over-the-wire dilation balloons (e.g., biliary dilation balloons) under fluoroscopic guidance. Biliary dilation balloons are available in sizes ranging from 4 to 10 mm with lengths from 2 to 8 cm and can be used with endoscopically placed 0.035-inch guidewires. The advantages of balloon dilators include the radial force that is applied to the stenosis and the avoidance of the application of axial force. Balloon dilators can be advanced through the endoscope channel and carefully pushed forward into and through the stenosis under direct vision. Balloon dilators may also be inserted, on the side of the endoscope itself or under fluoroscopic control, over a guidewire that has previously been inserted through the scope [40].

Pneumatic dilation for treatment of achalasia in children is successfully performed [41].

1.4.6.3 Esophageal Stents

There are no esophageal stents designed for pediatric use.

Two different strategies for stenting have been described.

– Rigid stent: the metal and plastic stents press against the esophageal wall, with food and secretions that pass through the stent itself.
– Dynamic stent: a plastic or silicon tube fixed to a nasogastric tube. Food and secretions passing repeatedly in the space between the stenosis and the stent itself seem to effectively maintaining lumen patency [42].

The use of plastic and nitinol esophageal and airway stents has been reported in treating recalcitrant esophageal strictures in children in case series [43]. The smaller diameter (10–20 mm) and shorter length (20–80 mm) of the airway stents may

make them more suitable in smaller patients [43, 44], such as endoscopic biliary accessories safely used to dilate refractory esophageal strictures [45].

The choice of a particular stent must be based on the location and characteristics of the stricture as well as the size of the patient.

1.5 Conclusion and Future Directions

Pediatric gastrointestinal endoscopy continues to evolve favorably, and provides a safe and effective diagnostic tool. The most frequently performed procedures are EGD and colonoscopy. Wireless capsule endoscopy or double-balloon enteroscopy for investigation of the small intestine can be performed alternatively to magnetic resonance enteroclysis, which remains the only choice in infants. Therapeutic procedures such as polypectomy, endoscopic hemostasis of gastrointestinal bleeding, retrieval of foreign bodies, ERCP, or ligation of esophageal varices can also be performed in infants.

Endoscopy is fundamental to the care of IBD: It is used to make an initial diagnosis, distinguish CD from ulcerative colitis, assess disease extent and activity, monitor response to therapy, survey for dysplasia, and provide endoscopic treatment such as ileocolonic dilation. A further application in pediatric IBD concerns the ileal pouch endoscopy in patients with ulcerative colitis (UC) who require colectomy (for the endoscopic and histological assessment of pouchitis, pouch leakage, or other local disease), and colorectal cancer screening and surveillance, in patients with long-standing UC and extensive CD colitis who are at risk for development of dysplasia and colorectal cancer [37].

In recent years, the increased use of pediatric endoscopy in clinical practice is stimulating industry to produce specific tools and accessories, although a greater availability of pediatric instruments and accessories would be desirable.

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