Upper GI Endoscopy in the Diagnosis of Gastropathy

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Mike Thomson

There is clearly no substitute for visual diagnosis reinforced by histological biopsy assessment in the diagnosis of mucosal pathology involving the stomach in children. The inflammatory pathologies which cause symptoms are amenable to diagnosis and differentiation with this tool, and anatomical abnormalities can also be identified. A distinction between "gastropathy," which is the term used for description of visual abnormalities at endoscopy involving the stomach (and encompassing histological pathologies), should be made in contrast to the term "gastritis," which is taken to indicate histological inflammation. In other words "gastritis" is a term that should not be used by the endoscopist to describe their *macroscopic* determination of pathology as this is a *microscopic* diagnosis. This important distinction is elegantly drawn by [1].

More detailed reviews of infant gastropathology and technology can be seen in other texts [2].

This chapter will not deal with histological diagnoses, which are dealt with in detail in Chap. 111. Rather it will describe the process, tools, ideal environment, methodology, and macroscopic diagnoses which are required by, and attributable to, upper GI endoscopy in children. More extensive detailed expositions on pediatric endoscopy in general are available [3, 4].

M. Thomson
Sheffield Children's Hospital, Sheffield, UK
e-mail: Mike.Thomson@sch.nhs.uk

Process

Clearly the first issue is to make a decision that gastroscopy as part of an upper GI endoscopic assessment will be an investigation in an individual child that will actually alter patient management. Symptoms of gastric pathology may be indistinguishable from that arising from the esophagus or duodenum, e.g., dyspepsia, nausea, and regurgitation. In this scenario examination of the upper GI tract may be of advantage in differentiation of the origin of the symptom and hence directing appropriate management. Symptoms and their origin are examined in other parts of this book. Once the decision is made to proceed to EGD, then the child and family should have adequate information made available to them, with the possibility of reflection on the decision to move ahead to EGD available. Leaflets, a web presence, endoscopy unit visits, and face-to-face explanations are obvious ways for these issues to be addressed, and consent from parent and, if needed or desired, child would then be "informed" consent. All parts of this patient's journey should be subject to examination in training.

Ideally the unit would be close to, or part of, a pediatric ward, although not unreasonably endoscopy units may exist within a theater complex; occasionally, although certainly less than ideal, the existence of a unit is within a larger adult endoscopy facility. Recovery facilities may, and probably should, preclude such an arrangement.

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Age-appropriate material with cartoons, videos, and distraction by play therapists and concealment of any potentially scary equipment may make the initial impression less than forbidding for the child. Age-appropriate interaction with the child is the most important strand however. Excessive noise from adjacent rooms, protection of privacy, adjustable temperature, and lighting are all common sense measures which do not need to be reiterated here.

The recovery area would also be child-friendly and equipped with resuscitation equipment.

Clean and dirty areas for scope processing are considered mandatory nowadays with through-the-hatch-type processors, and guidance for setting up such an area is freely available in most countries by visiting websites such as that of the British Society of Gastroenterology (www.bsg.co.uk).

GI endoscopy is an invasive procedure and in almost all children has the potential to cause great distress if performed without adequate sedation or general anesthesia. Unfortunately for some children, pediatric endoscopy is still sometimes performed without any or with minimal so-called conscious (although it rarely is so) sedation. Although there is an obvious need to alleviate distress in infants and children undergoing endoscopic procedures, there is no consensus on the best approach. The choice is between sedation and general anesthesia. The ideal sedative regimen would be effective for every patient, act rapidly, induce an adequate but safe levels of sedation for the duration of the procedure, wear off immediately afterward, and have no adverse effects. No such regimen exists. For this reason, many advocate the use of general anesthesia for pediatric endoscopy. Others disagree, arguing that sedation has an essential role in pediatric practice and that for GI endoscopy it can be both safe and effective. The logistic and financial implications of relying on general anesthesia must also be considered. The true morbidity and mortality rates associated with pediatric endoscopy, whether performed under general anesthesia or sedation, are unknown.

From a practical point of view, it is generally considered possible to distinguish between two distinct levels of CNS depression, referred to as "conscious sedation" and "deep sedation." The distinction between these states is central to the debate about safety and efficacy. The term conscious sedation implies a level of CNS depression in which communication is maintained so that the patient can respond to verbal command. The term deep sedation implies a level of CNS depression in which the patient is essentially unconscious and does not respond to verbal command. Practically it is rare that conscious sedation state is used in pediatric endoscopy, and therefore by any safety standards, it is recommended that one practitioner, usually a pediatric anesthesiologist, is dedicated to the safety of the child and administration of whatever method of deep sedation/GA is used. The mode of this is less important, i.e., safe airway, successful completion of procedure, no distress, timely execution, and ability of the endoscopist to concentrate on their responsibility of carrying out the procedure without having to worry about the child's safety; these are the important considerations [5–7].

Tools

Endoscopy and mucosal biopsy are a cornerstone of modern pediatric gastroenterology practice. The ability to make an accurate tissue diagnosis has been a major factor in the development of pediatric gastroenterology. Endoscopy continues to evolve, and in today's age, pediatric gastroenterologists are using the endoscope not only as a diagnostic device but increasingly as a therapeutic tool and vehicle by which to deliver endoluminal, and even extraluminal intraperitoneal, minimally invasive therapies, although these remain some way off. These are early days, but obvious initial benefits are saving procedure time, hospital admission time, and avoidance of surgical morbidity. In due course therefore the stomach may provide a portal to the peritoneum allowing natural orifice endoluminal therapeutic endoscopic surgery (NOTES) to occur. This is dealt with in Chap. 111, and its value is yet to be fully determined.

Evolution of Endoscopes

Internal examination of the human body dates back to Hippocrates (460–377 BC). He used a speculum for rectal examination, and in his treatise described rectal inflammation, hemorrhoids, and fistula. Abu Al-Qasim Khalaf ibn Abbas az Zahrawi (930–1013 AD), an eminent surgeon in Cordoba, Spain, ingeniously added a light source (reflected light by a glass mirror) for examination of the cervix. In 1806, Philipp Bozzini, a German physician from Frankfurt, invented the "lichtleiter" (light conductor) using the candle as source of illumination [8]. Visualization was limited; the examination was unfortunately painful to the patient. The Vienna Academy of Medicine did not view it kindly and reprimanded him for being "too curious." The French physician Antonin J. Desormeaux in 1858 resurrected Bozzini's invention and developed the "lichtleiter" further, replacing the candle by the much brighter gas flame using alcohol and turpentine as fuels [9].

Kussmaul performed the first esophagogastroscopy on a professional sword swallower. He swallowed a 47 cm long, 13 mm diameter metal tube. Unfortunately the Desormeaux lamp (gas illumination) had inadequate light failing to illuminate. To counter illumination problems, Leiter and Nitze used loops of platinum wire as filaments for electric lamps operated with galvanic batteries [10]. These lamps could get very hot, and in addition they devised a cooling mechanism for the hot light source eventually performing the first successful gastroscopy. They ended up arguing about the resulting credit, and historically they came to blows engaging in vitriolic correspondence. Leiter later collaborated with Johann von Mikulicz, successfully moving the light source to the distal end of the endoscope [11].

The first flexible gastroscope was invented by Dr Rudolph Schindler in 1932 [12]. The gastroscope was 75 cm long and 11 mm in diameter. About one third of the entire length of the tube toward the end could bend by an angle of 34° without distorting the image. A number of short focus lenses were positioned throughout the tube, and the light source was a miniature light bulb. This semiflexible gastroscope remained in popular use until 1957.

The fiberoptic era was born when, in the American gastroscopy society meeting of 1957, Hirschowitz successfully demonstrated the prototype, formulated with the help of a physicist [13]. In 1960 ACMI Ltd produced the first commercial fiberoptic gastroscope. Robert Kemp in 1962 suggested using a controllable directional tip helping to develop it further.

In 1983 the first digital endoscope was produced by Welch Allyn. At the tip was an electronic sensor consisting of packed grid of photocell receptors which electronically transmitted images to a video processor and then to a television monitor. This evolution has particularly accelerated the endoscopist's training, additionally adding to the interest of all present in the theater including the patient (Fig. 112.1).

The use of gastrointestinal endoscopy in the pediatric population was initially driven by the imperative of histological diagnosis in conditions such as celiac disease and the inflammatory bowel diseases. It has superseded such modalities as the Watson-Crosby capsule for obtaining small

Fig. 112.1 A Hirschowitz gastroscope recently (Nov, 2006) sold on eBay for 68.50

bowel mucosa and offers advantages over these methods by way of observation of the whole of the upper GI mucosal surface and anatomy while providing as many biopsies as are needed for diagnosis of esophagogastroduodenal pathology; indeed the duodenal biopsies provided have been shown to be as good as those obtained by capsule without the necessity for screening irradiation and usually occurring in a more controlled airway setting of general anesthetic [14].

The use of diagnostic GI endoscopy in children has followed developments in the adult sphere and is now considered standard practice for all mucosal GI diseases. Indeed modalities such as wireless capsule endoscopy and double balloon enteroscopy added to upper GI endoscopy and ileocolonoscopy now enable the pediatric endoscopist to visualize and biopsy the whole of the gut from mouth to anus [15–17].

The more recent advances of therapeutic intervention have transformed areas such as enteral nutrition support with PEG and PEJ tube insertion, esophageal stricture management, and especially variceal and non-variceal bleeding management and are now considered mandatory for any advanced pediatric endoscopist.

Technique of Endoscopy Involving the Stomach

The instrument will pass down the narrow confines of the esophagus without difficulty. It is important to make any necessary adjustments to keep the esophageal lumen at the center of view (Fig. 112.2). Insufflation of air from time to time will maintain a clear view. The gastroesophageal junction is identified using a number of anatomical features.

First, the z-line, or dentate line, of the gastroesophageal mucosal junction may be visible, the esophageal mucosa appearing pale compared with the salmon-pink gastric mucosa (Fig. 112.3).

Second, the gastric rugae may be seen immediately distal to the esophageal mucosa. Last, there may be an area of relative luminal narrowing at the level of the diaphragm, the "diaphragmatic pinch." Each of these indicators should be evaluated because in individual patients, some may be more reliable than others. A sliding hiatus hernia can be confirmed by noting that the z-line and gastric rugae lie above the diaphragmatic pinch (Fig. 112.4). Similarly, in patients with Barrett's esophagus, the z-line may be proximally displaced (Fig. 112.5). Finally, before advancing through the gastroesophageal junction, aspiration of air reduces the intraesophageal pressure and may reveal small esophageal varices

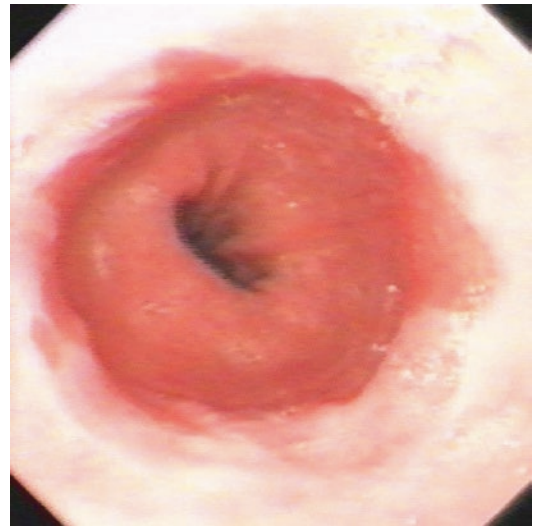

Fig. 112.2 Esophageal lumen

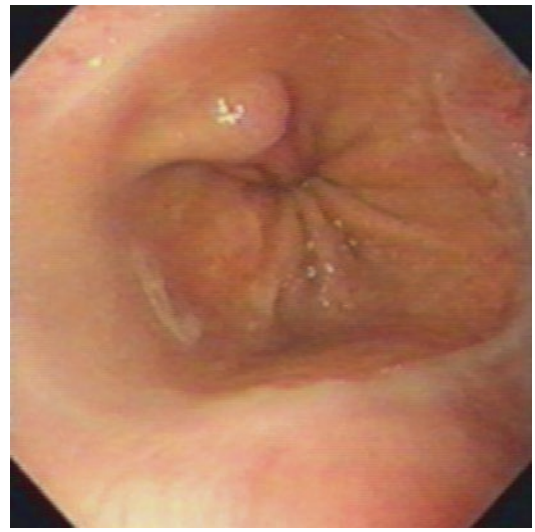

Fig. 112.3 Dentate or z-line, with an inflammatory polyp

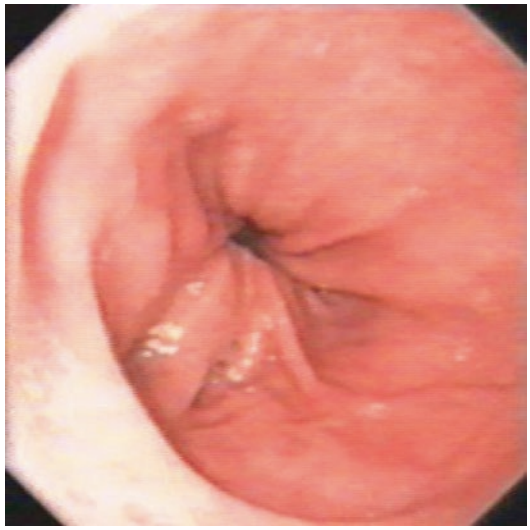

Fig. 112.4 Hiatus hernia showing diaphragmatic "pinch"

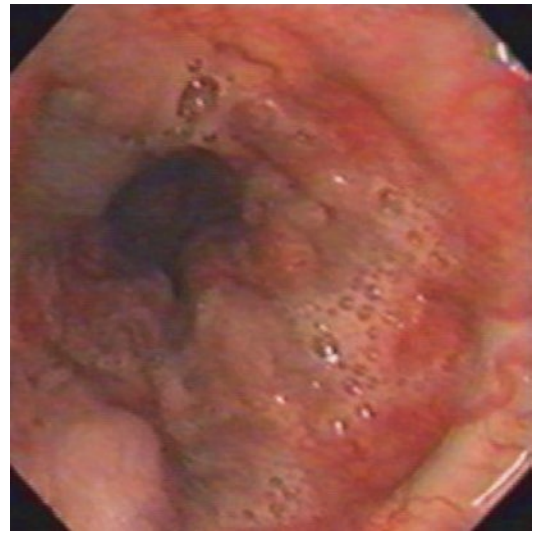

Fig. 112.6 Esophageal varices

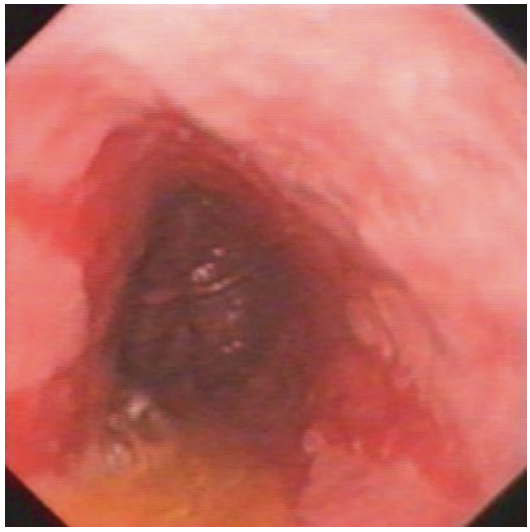

Fig. 112.5 Barrett's esophagus

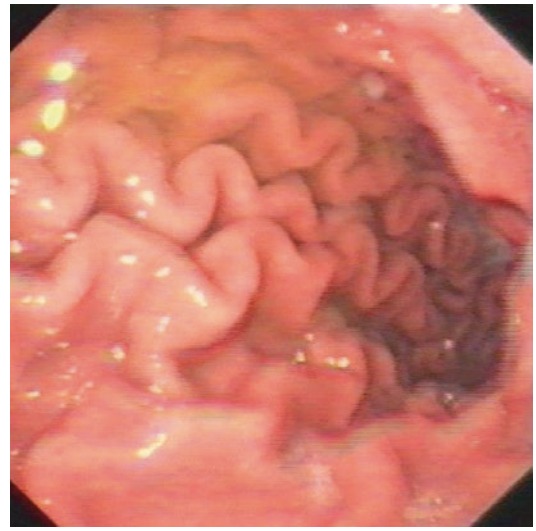

Fig. 112.7 Gastric rugae

that might not otherwise be obvious (Fig. 112.6). The endoscope moves easily through the gastroesophageal junction, but immediately upon entering the stomach, the forward view may be obscured by gastric mucosal folds in the cardia. At this point adequate insufflation of the stomach is necessary to gain a clear view. Aspiration of pooled gastric secretions is critical prior to full distension of the stomach to minimize the risk of aspiration. As air is insufflated, the gastric lumen and the gastric rugae are evident, but with further distention, the rugae gradually flatten (Figs. 112.7 and 112.8). As the endoscope is advanced, it readily slides down along the greater curvature of the stomach to the gastric antrum, facilitated by clockwise torque, advancement, and upward tip deflection. The lesser curvature may be seen on the right, and often the prominence of the area gastricae can be noted (Fig. 112.9). This is a normal mosaic appearance and finding, although

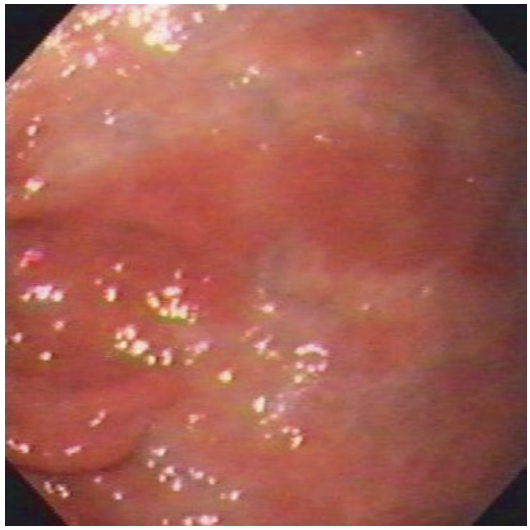

Fig. 112.8 Insufflation expands stomach and therefore rugae disappear

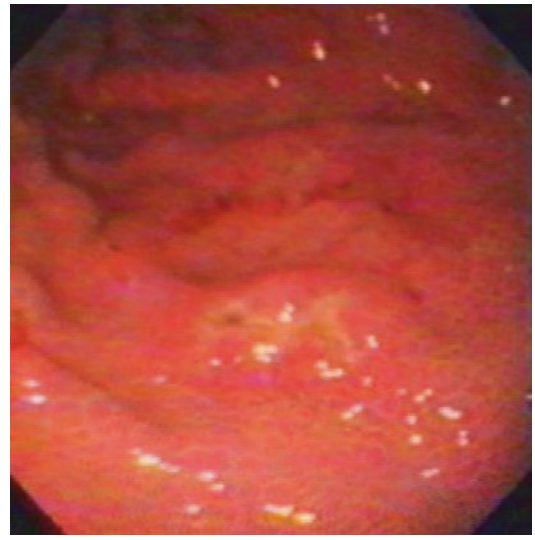

Fig. 112.10 Crohn's of stomach: mosaic appearance of edema

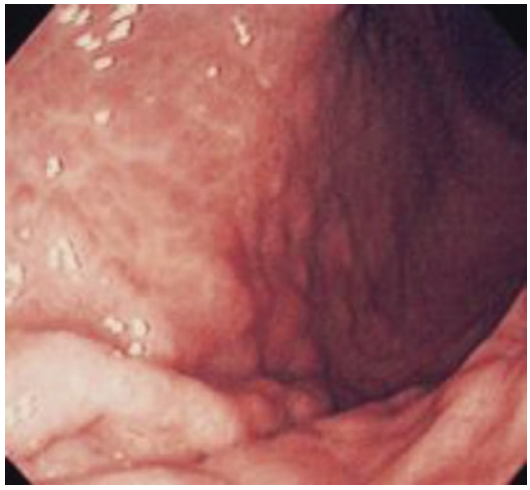

Fig. 112.9 "Area gastricae": prominent area on lesser curvature of stomach which is a normal finding

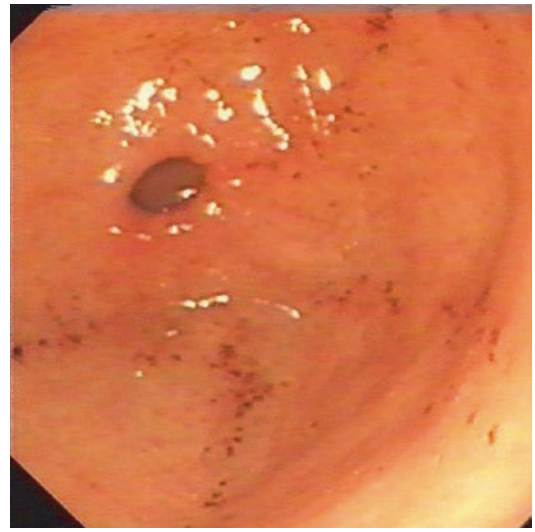

Fig. 112.11 Pylorus

if seen elsewhere in the stomach it can point to the possibility of inflammation such as Crohn's disease [18] (Fig. 112.10). Very often as the endoscope reaches the antrum, the pylorus comes into view (Fig. 112.11). However, in infants and small children, the pylorus is often located very close to the angulus incisura, and the angle of approach is necessarily somewhat acute (Fig. 112.12). In this case it can be very helpful to perform a so-called "J-maneuver" of the endoscope. The endoscope is retroflexed in order to look back up the stomach (thus adopting a "J" configuration). Then with some minor adjustments, it is usually easy to look face-on at the edge of the angulus incisura. The pylorus lies a few centimeters distal to the angulus. Once visualized with this maneuver, the line of approach is

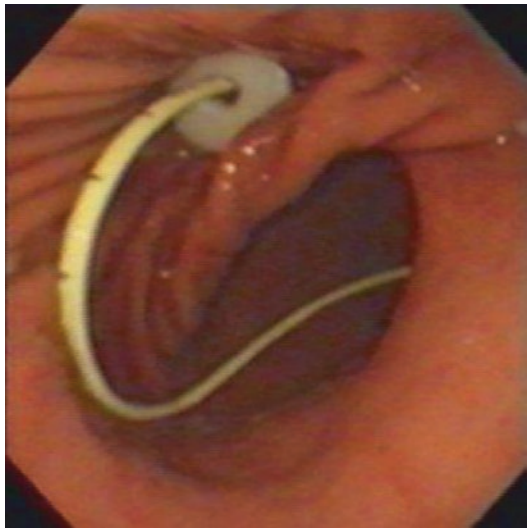

Fig. 112.12 Angula incisura around which a PEGJ tube has been passed into the pylorus

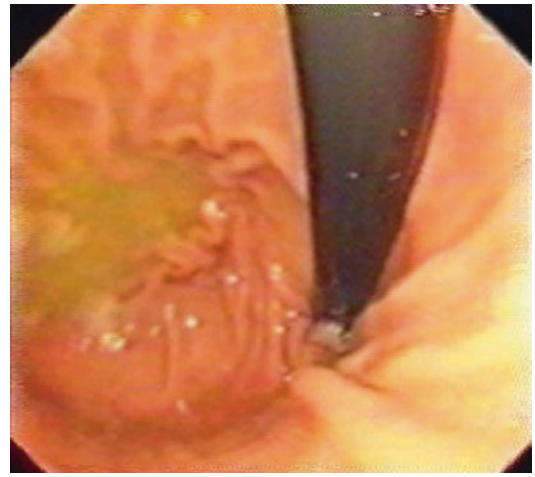

Fig. 112.13 J manuever to see the cardia and fundus

clear. The J-maneuver can also be very helpful in performing a thorough examination of the gastric fundus and cardia (Fig. 112.13). The gastric body lies proximal to the angulus and further proximally is the fundus and the gastroesophageal junction through which the shaft of the endoscope is to be seen passing downward (Fig. 112.13). If the endoscope is carefully withdrawn in the retroflexed position and some lateral and rotational adjustments are made, thorough examination of the entire gastric mucosa is possible.

Once the entrance to the pyloric canal is visualized, intubation is usually straightforward. If the pylorus is closed, it appears as a series of mucosal folds radiating from a central point. With gentle pressure, sometimes assisted by a brief puff of air, the endoscope will usually pass easily into the pylorus.

Biopsies are usually taken from the antrum which can be 2 or 4 in number, and this is the area with highest yield for *Helicobacter pylori*, and the body. A rapid urease test for *H. pylori* is also usually obtained. Some children have *H. pylori* identified in the fundus also. Any lesion should be photographed and if necessary biopsied. Gastric aspiration for identification of TB may be helpful. More recent innovations such as narrow band imaging, autofluorescence, and now confocal endomicroscopy with up to 1,000× magnification (i.e., histology in vivo) allow specific targeting of biopsies to areas likeliest to provide highest diagnostic yield [19] (Figs. 112.14, 112.15, 112.16, 112.17, and 112.18).

Diagnostic Indications

These are varied and are summarized in Table 112.1. Each pathology is identified and examined in more detail in the relevant chapter with description of macroscopic and histological appearances so this will not be undertaken here.

It is clear that the major impact over the last 20 years on identification of mucosal pathology and its potential symptomatic causation has been the endoscopic assessment and biopsy. Each pathology will not be dealt with here, but the reader is directed to the appropriate mucosal and symptom-specific chapter.

Therapeutic Endoscopy of the Stomach

These are summarized in Table 112.2, and as they are not dealt with elsewhere in the text, it will be touched upon here as follows.

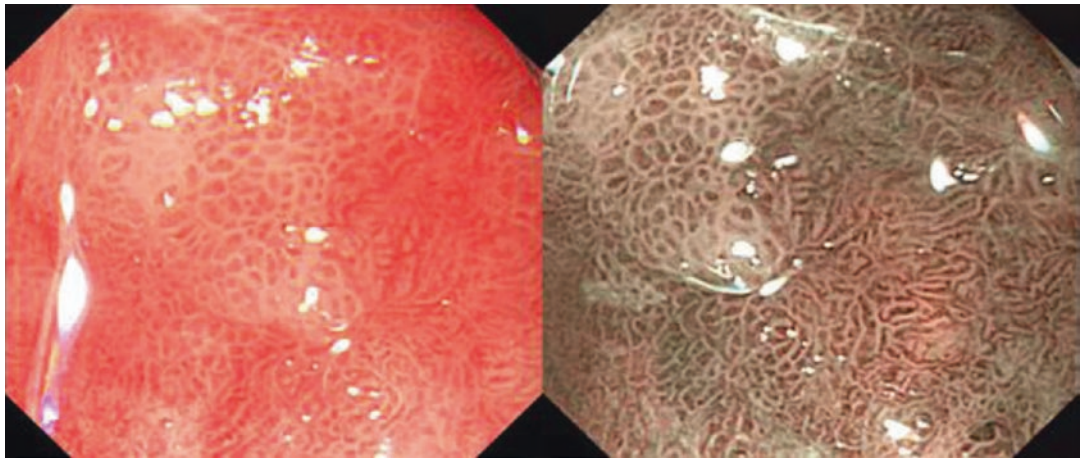

Fig. 112.14 Narrow band imaging (*right*)

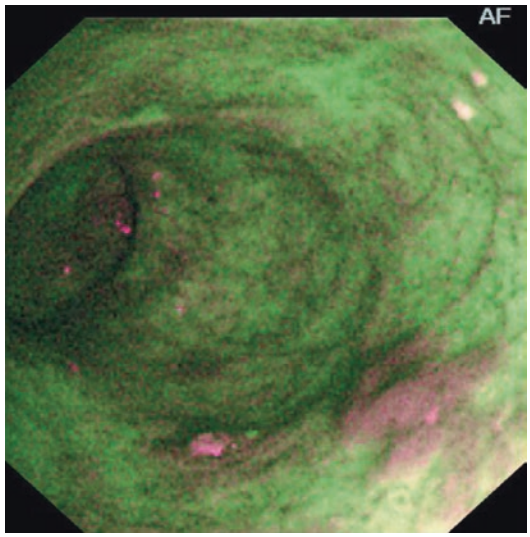

Fig. 112.15 Autofluorescent endoscopic imaging

Fig. 112.16 Tip of confocal endomicroscope revealing laser imaging portal

Gastric Bezoar

The term "bezoar" derives from the Persian word *badzehr*, which means antidote. Some types of trichobezoar are able to precipitate or bind arsenic compounds (a commonly used ingredient in the poison) hence acting as an antidote. In 1575, Ambroise Paré, a French army physician and surgeon, proved this to be wrong, an experiment which costs the cook his life. A cook at Paré's court was caught stealing fine silver cutlery who agreed to be poisoned. Despite using the bezoar stone, he died in agony days after. Paré had proved that the bezoar stone could not cure all poisons as was commonly believed at the time.

Bezoars are of several types with phytobezoars being the commonest type. These are soft and are composed of plant and vegetable fibers [20]. In comparison trichobezoars are composed of hair, undigested fat, and mucus. The hair may come from the patient, other humans, animals, carpet fibers, or blankets. Hair fibers are trapped

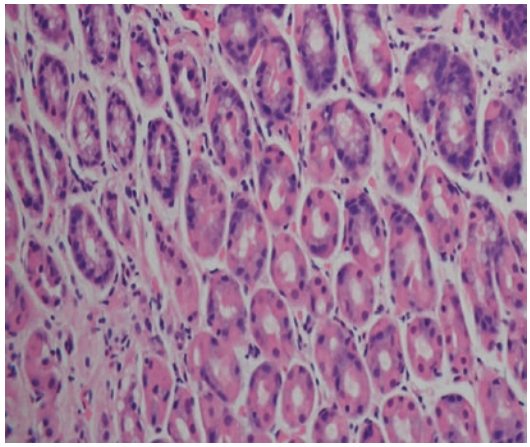

Fig. 112.17 Gastric histology "en face"

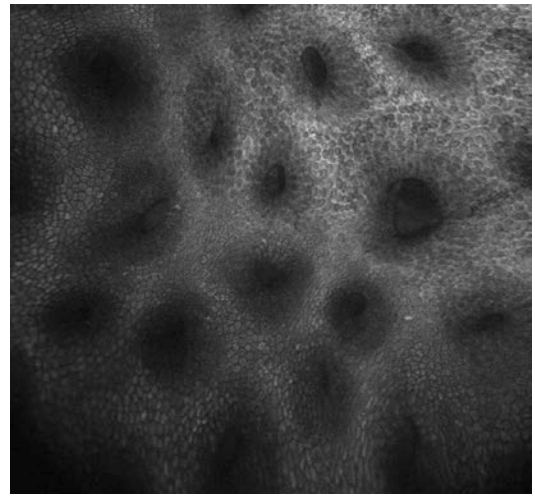

Fig. 112.18 Surface endo-histology of the stomach at confocal endomicroscopy

Table 112.1 EGD and diagnostic indications involving the stomach

Mucosal injury and inflammatory pathologies	Bleeding lesions	Miscellaneous
Acute (stress) ulceration	Acute (stress) ulceration	Bezoars
H pylori gastritis	Gastric fundal varices	Ectopic pancreas
H pylori gastric ulcer	Portal gastropathy	Adenomatous polyps (e.g., Gardner's and FAP)
NSAID gastritis	Dieulafoy's lesions	Hamartomatous polyps (Peutz-Jeghers polyposis)
Eosinophilic gastritis	*H. pylori* gastric ulceration	Gastric carcinoma, lymphoma, leiomyoma, leiomyosarcoma, mucosal-associated stromal tumor (MAST), GOJ tumors
GVHD	Virus-related hemorrhagic gastritis (esp. Influenza A)	GAVE (gastric-associated vascular ectasia or watermelon stomach)
Autoimmune gastritis	Drug-related gastritis	
Atrophic gastritis	GAVE (gastric antral vascular ectasia or watermelon stomach)	
Crohn's and UC-related gastritis		
Varioliform gastritis		

in gastric folds and resist peristalsis because they are slippery. More hair is added, and a ball forms. The hair protein is denatured by gastric acid, causing the ball to turn black. Fat becomes trapped in the hair fibers and ferments, leading to a putrid smell.

One variant of trichobezoars is the "Rapunzel syndrome." This is a trichobezoar extending from the stomach into the small intestine sometimes even involving entire length of the small intestine. The twisted hairs can become hard like a wire. There are reports in which these can cause compression of the mesenteric wall of the intestine occluding the blood supply resulting in pressure necrosis and perforations [21, 22] (Figs. 112.19, 112.20, and 112.21).

Endoscopy or surgery may be used to remove bezoars. With the help of an endoscope, these are broken into smaller pieces using a polypectomy snare, biopsy forceps, directed water jets [23],

Table 112.2 EGD and therapeutic indications involving the stomach

Gastric fundal variceal banding
Gastric fundal variceal histoacryl glue injection
Non-variceal bleeding lesion clip application, thermocoagulation, or argon plasma coagulation
Foreign body removal (esp. sharp objects and mercury or lithium batteries)
Percutaneous gastrostomy insertion
Percutaneous gastrojejunostomy insertion
Pancreatic cystogastrostomy
Pyloric balloon dilatation
Endo-pyloromyotomy with needle knife or tapered myotome
Botulinum toxin injection into pylorus
Pancreatic pseudocyst transgastric drainage
Polypectomy
Anti-obesity endotherapy
Notes

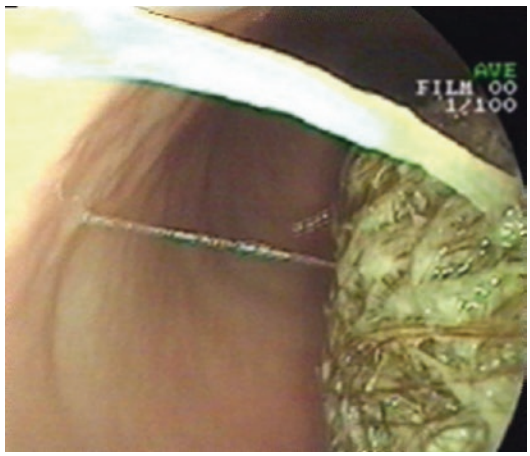

Fig. 112.19 Endoscopic view of the large gastroduodenal trichobezoar

injection of enzymes (papain, cellulose), or mechanical lithotripsy (bazotome, a needle knife device, or bezotriptor, a lithotriptor) [24]. Fifteen patients were treated with mechanical lithotripsy with a 100 % success rate (five patients required two sessions). Gastroscopy re-performed 3 days later showed only four patients with small residual bezoar fragments, which were removed endoscopically. Once the bezoar is broken into smaller pieces, these can then either be removed endoscopically or allowed to pass through the pylorus.

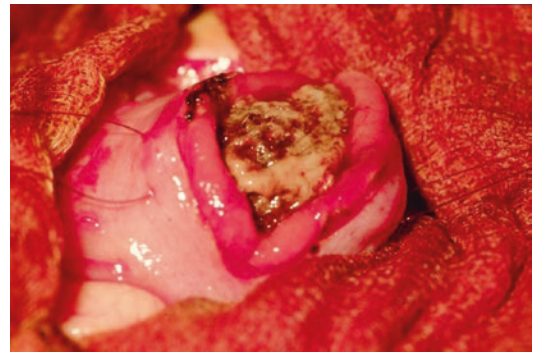

Fig. 112.20 Surgical removal of trichobezoar

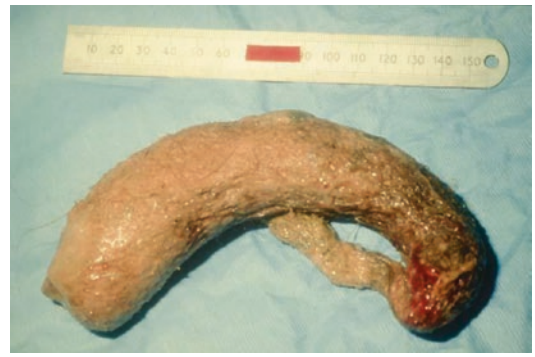

Fig. 112.21 Bezoar from an 11-year-old girl with Rapunzel syndrome. The large size (34 cm long and 8 cm in diameter) did not permit endoscopic removal

Another group has reported use of electrohydraulic lithotripsy (EHL) to treat bezoars [25]. After submerging the bezoar in saline, the EHL probe was brought into direct contact with the mass and used to deliver a series of short bursts that fragmented the bezoar into pieces 1–1.5 cm in diameter. Uncomplicated 100 % success (11 patients) was reported. In addition there was no recurrence after 30–68 months follow-up.

A group in China has reported use of a mini-explosive device to treat diospyrobezoars [26]. Hydrazoic acid (trizoic acid) is a colorless, volatile, and extremely explosive liquid at room temperature and pressure. All the salts are explosive and readily interact with the alkyl iodides. The metallic salts all crystallize in the anhydrous form and decompose on heating, leaving a residue of the pure metal. It is a weak acid (pKa 4.6–4.7). In this report trizoic lead was loaded into small steel tubes (0.5 cm thick, 1 cm in length, and 2 mm in

diameter). These were connected to a pulsed neodymium laser. The device was passed through the endoscope and placed in direct contact with the bezoar. The laser was ignited, followed by a mini-explosion and a small hole in the bezoar. After three to five of these explosions, bezoar fragments were then removed with a snare. Gastric mucosa was intact in all patients (except a small erosion in one patient). No discomfort was reported during the procedure, and 21/31 patients were cured in one treatment session. Patients reportedly felt no discomfort. This method with its hazards is unlikely to be adopted worldwide.

Coca-cola [27] was used in a 42-year-old man in four aliquots of 30 mls. Each aliquot was injected into the bezoar with the endoscope being forcefully buried into the bezoar at four different places. Thereafter the diet was restricted for 48 h. A repeat endoscopy showed the bezoar had cleared from the stomach.

Endoscopic Pyloromyotomy for Congenital Pyloric Stenosis

Ramstedt's pyloromyotomy (open and laparoscopic) has been the gold standard operation for treatment of congenital pyloric stenosis for more than 80 years. Recently Ibarguen-Secchia from Texas has reported use of endoscopic pyloromyotomy in a series of ten children [28]. Transendoscopic use of a needle knife or a sphincterotome was used in a quadrantic manner through the mucosa, and division of the internal hypertrophied circular muscle was carried out. Prior endo-ultrasound can help in the decision as to how deep to make the incision, but standard transabdominal ultrasound is sufficient. The route of treatment is somewhat more appropriate than dividing the serosa and outer normal longitudinal muscle as in the standard approach, and it has not seemed to matter that the mucosa is divided. This was performed with a view to achievement of a quicker operation and post-op recovery time. Nine out of ten children had the procedure as a day case, and one out of ten needed electrolyte correction before being treated the next day. All children were fed only after an hour of the procedure compared to the median time of 38 h for laparoscopic pyloromyotomy and 64 h for an open abdominal procedure. Vomiting continued to a lesser degree in two but eventually resolved in all over a 6–18-month follow-up. The results are impressive. However, this is only a one operator-conducted small case series; clearly, one needs to be cautious about bleeding and perforation, which may cause significant morbidity particularly in this younger age group (Figs. 112.22 and 112.23).

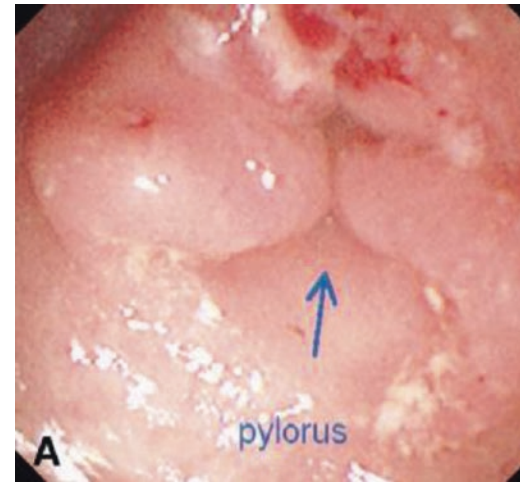

Fig. 112.22 Pre-endo-pyloromyotomy in pyloric stenosis (Permission from Dr E. Iguardo-Secchia)

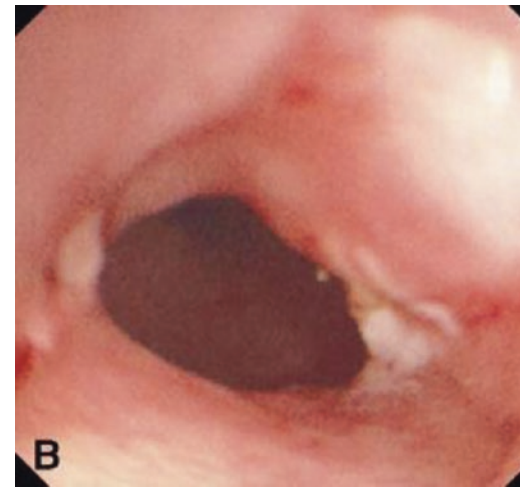

Fig. 112.23 Post-endo-pyloromyotomy in pyloric stenosis (Permission from Dr E. Iguardo-Secchia)

Percutaneous Endoscopic Gastrostomy and Gastrojejunostomy

Percutaneous endoscopic gastrostomy tubes are very commonly used since their first development by Ponsky and Gauderer 25 years ago [29]. These were devised to provide hydration and nourishment to the neurologically impaired children unable to swallow. PEG, in particular, was developed to avoid complicated surgery.

PEG tubes may be inserted using a "pull" or a "push" technique. The "pull" technique was pioneered by Ponsky and colleagues [30]. This involves performing a gastroscopy, identifying the anterior stomach wall making sure that there is no organ (particularly the spleen) that is between the wall and the skin. An angiocath is used to puncture the abdominal wall through a small incision, with insertion of a soft guidewire through this. The guidewire is pulled out of the mouth and a feeding tube attached to it and pulled through the mouth out of the incision (Figs. 112.24, 112.25, 112.26, 112.27, 112.28, 112.29, 112.30, and 112.31).

In comparison the "push" technique involves a gastroscopy to identify the anterior abdominal wall, and the wire is placed in the stomach using the Seldinger technique. A series of dilators are then used to increase the size of the gastrostomy with a tube then pushed over the wire. This is rarely performed now in children.

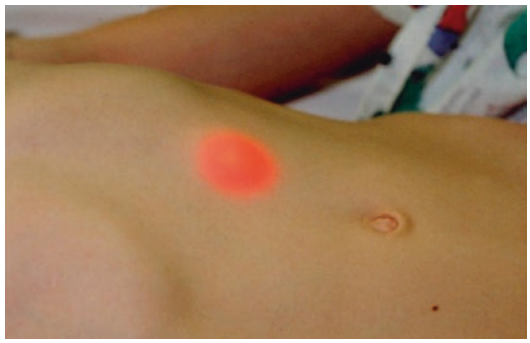

Fig. 112.24 Endoscopic transcutaneous illumination in left hypochondrium

The potential complications of gastrostomy insertion are injury to an organ such as the spleen during insertion of a gastrostomy tube, gastrocolic fistula (diarrhea may occur a short time after feeding), gastric separation, peritonitis, and gastrostomy site cellulitis (Figs. 112.32, 112.33, 112.34, 112.35, and 112.36).

Single-stage insertion of balloon gastrostomies can occur with or without laparoscopic

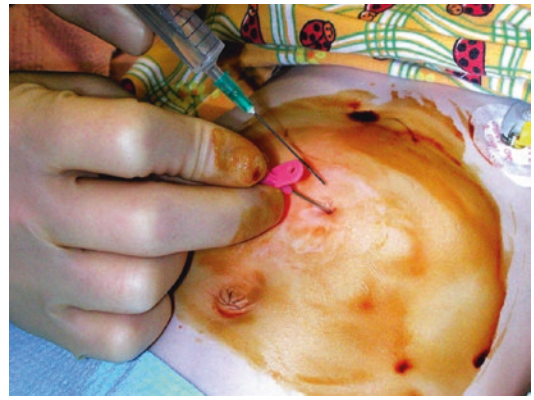

Fig. 112.25 Trochar placed through skin into gastric cavity. Note: needle with saline-filled syringe used first and inserted with suction in order to determine that the stomach is the first lumen entered, i.e., simultaneous aspiration into the stomach: the tip of needle enters the stomach and not colon. Helpful also in directing trochar insertion

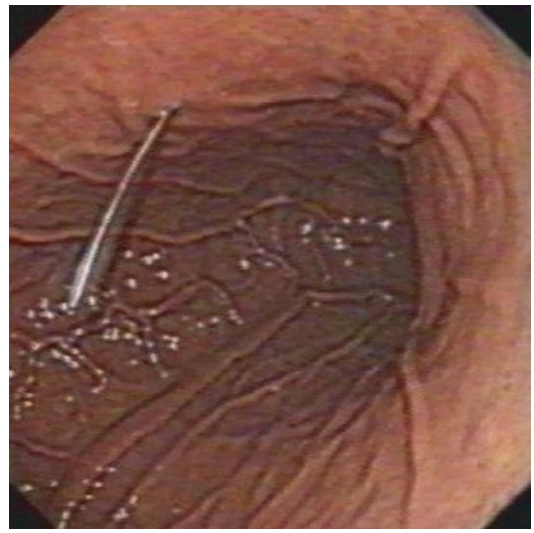

Fig. 112.26 Trochar placed into gastric cavity transcutaneously

assistance, although the blind technique using the endoscope can lead to pneumoperitoneum if not used with care. This technique has not gained wide popularity to date. Generally most operators will place a standard PEG first, allow the track to form over a period of approximately 3 months, and then perform a further endoscopy in order to change this to a correctly sized balloon gastrostomy tube, of which many exist on the market (Figs. 112.37 and 112.38).

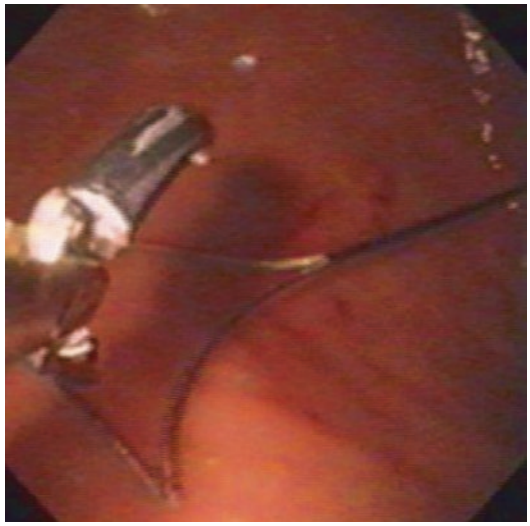

Fig. 112.27 Grasping forceps being employed to grab the wire passed through the trochar (Biopsy forceps or snare can be used)

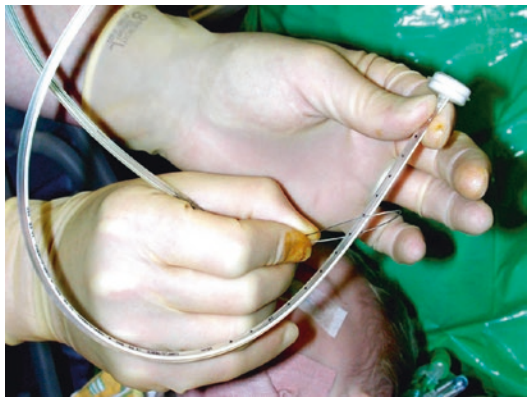

Fig. 112.28 CorFlo PEG being secured to pull-through wire which has been drawn out through the skin, stomach, and esophagus in a retrograde direction

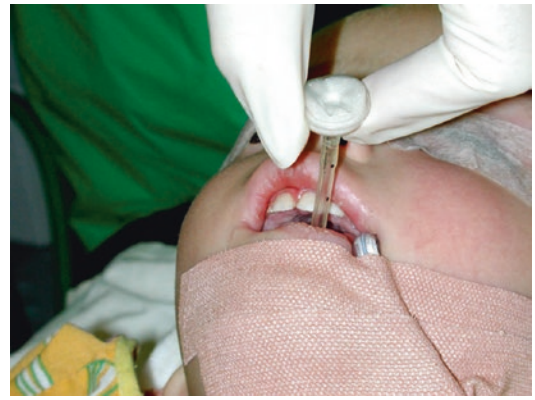

Fig. 112.29 CorFlo PEG being pulled through the mouth in an antegrade direction

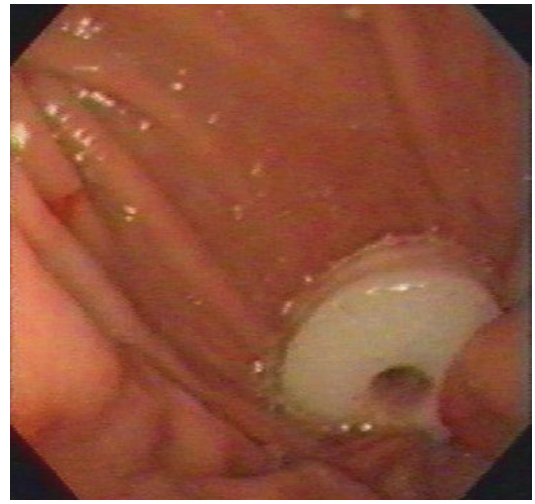

Fig. 112.30 Internal appearance of a CorFlo 12FG PEG

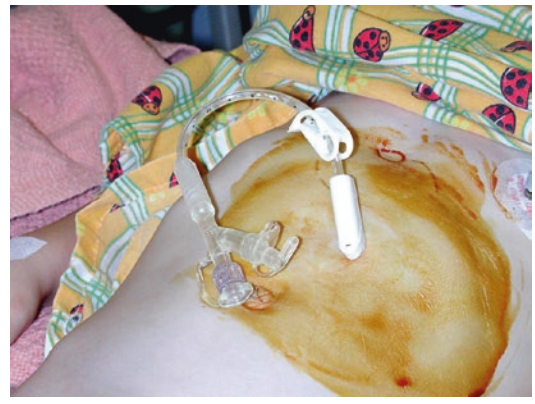

Fig. 112.31 External appearance of a 12FG CorFlo PEG

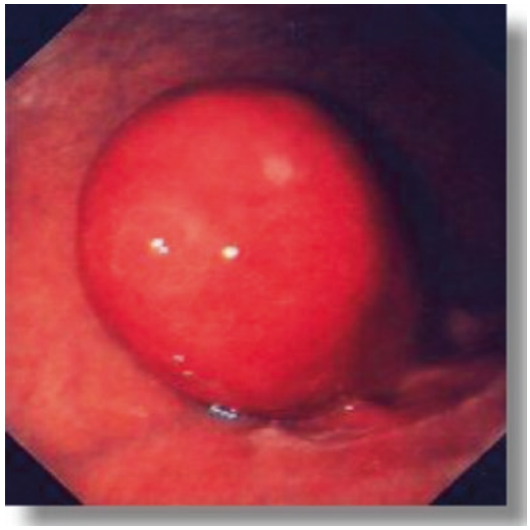

Fig. 112.32 "Buried bumper' syndrome. More common with Fresenius PEGs

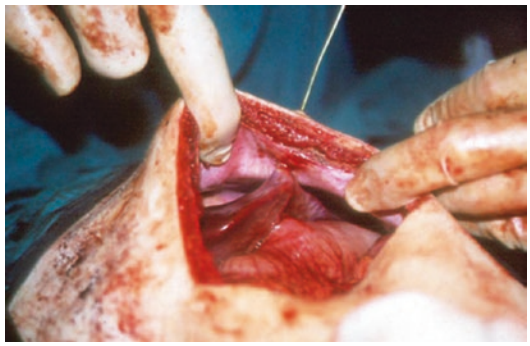

Fig. 112.33 Transhepatic PEG

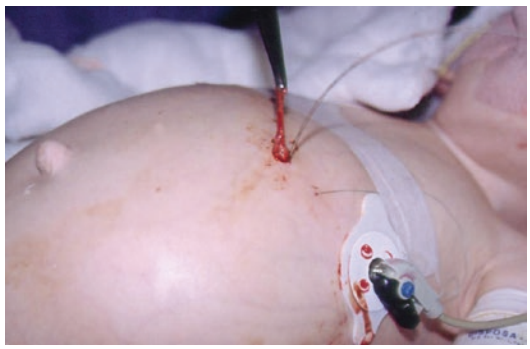

Fig. 112.34 Omentum brought out during procedure

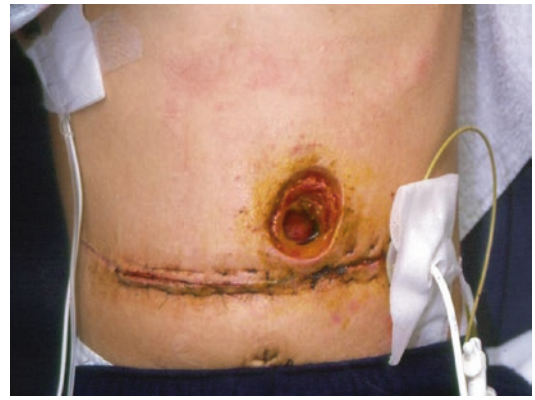

Fig. 112.35 Abdominal wall infection and dissolution

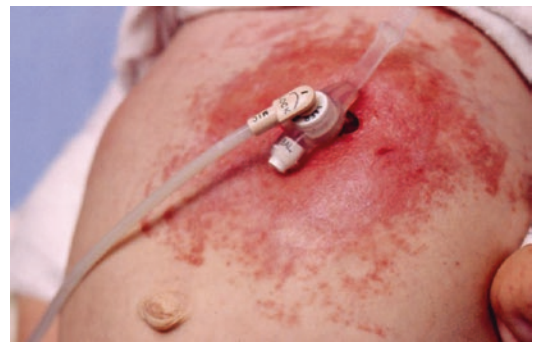

Fig. 112.36 Contact dermatitis to tape and dressing

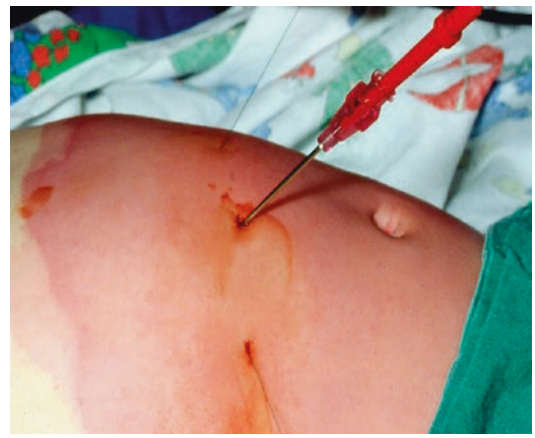

Fig. 112.37 Single-stage balloon PEG insertion. Step 1: apposition of stomach to abdominal wall with cope tags and then trochar-assisted insertion of J-wire

Using the PEG tube, it is also now possible to place a PEGJ tube. This involves placing a short PEG tube in the usual transgastric position. Through the lumen of that PEG tube, a thinner jejunostomy tube is placed. The jejunostomy tube then traverses the pylorus and extends

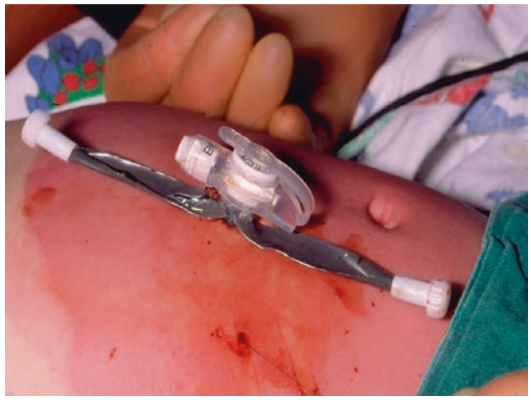

Fig. 112.38 Single-stage technique with splittable sheath placing one-step balloon gastrostomy

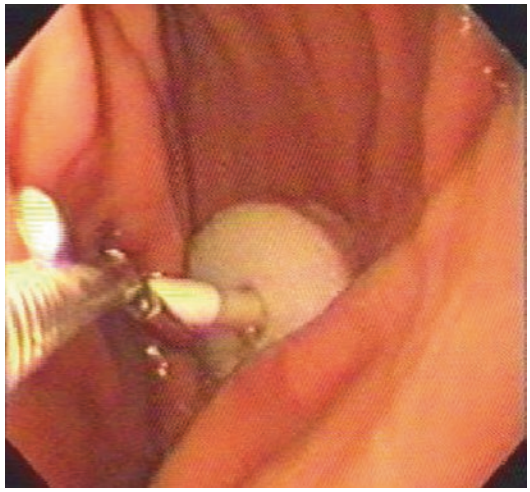

Fig. 112.39 Insertion of PEGJ lead 12FG through PEG 16FG and grabbed by grasping forceps

down beyond the ligament of Treitz. Although non-endoscopic direct placement of a PEJ tube across the abdominal wall into the proximal jejunum has also been reported, in general, jejunal tubes are fraught with problems and tend to get blocked or displaced easily. However more recently it has been possible to place a laparoscopically assisted percutaneous endoscopic PEJ with a similar technique to that employed with the PEG technique (Figs. 11 2.39, 112.40, and 112.41). Specific products and their intricacies are beyond the scope of this text, and the reader is referred to the standard pediatric endoscopic texts by Murphy et al. and Gershman et al. [3, 4].

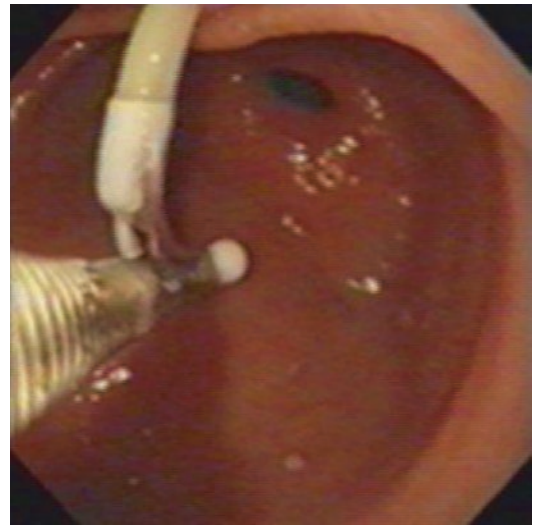

Fig. 112.40 Use of grasping forceps to place end of PEJ through pylorus

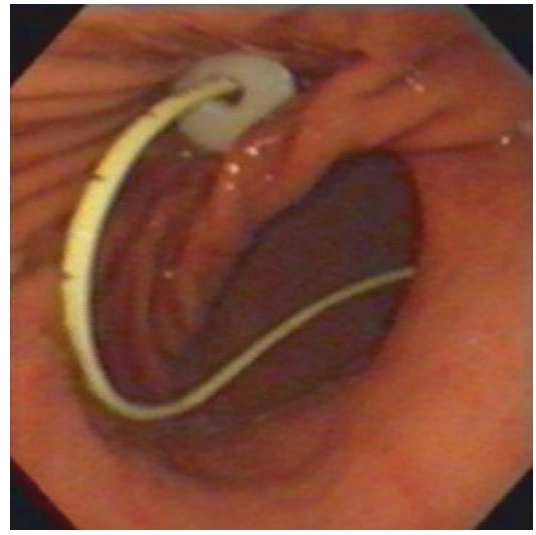

Fig. 112.41 PEJ now in situ from PEG site through pylorus

Gastric Bleeding

Although not popular for variceal treatments, due to ulcerogenic properties especially in the mid esophagus, injection of sclerosing or hemostatic agents is an option for initial treatment of gastric bleeding due to ulcers in the stomach or duodenum. It should be remembered that epinephrine injection via an endo-needle will tend to occasion

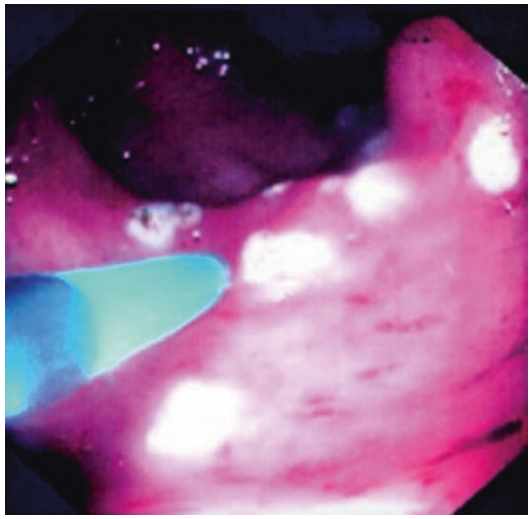

Fig. 112.42 Argon plasma probe and application in gastric bleeding

Fig. 112.43 Monopolar gold-probe electrocautery in gastric bleeding

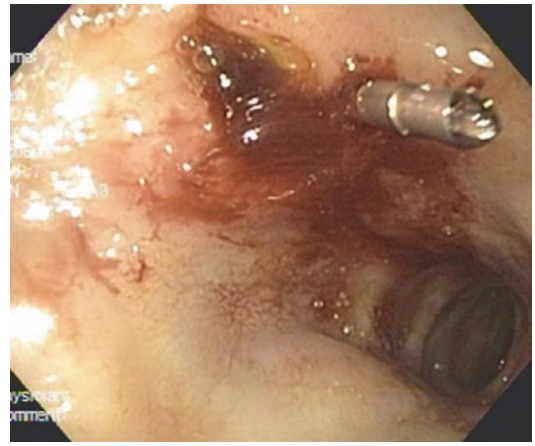

Fig. 112.44 Endoclip and application in gastric bleeding

only temporary vasospasm and bleeding cessation and will lull the operator into a false sense of security as 30 or so minutes later the bleeding may well reoccur as vasospasm resolves. Of course metal clips, referred to as endoclips delivered via the biopsy channel, can be very effective in conjunction with other techniques such as electrocautery and argon plasma coagulation in order to facilitate hemostasis. Gold-probe monopolar electrocautery (Figs. 112.42, 112.43, 112.44, 112.45, 112.46, 112.47, 112.48, 112.49, and 112.50) is also very effective for treatment of bleeding ulcers or preventing rebleeding in a patient with a non-bleeding visible vessel such as the Dieulafoy's lesion [31, 32]. Individual description of technique is beyond the scope of this chapter.

Foreign body removal is best described in the above standard endoscopic texts.

Pancreatic Cystogastrostomy

In the situation of pancreatic pseudocysts, usually the cystic mass produces a bulge into the gastric lumen, classically due to anatomical proximity, on the greater curvature. If noticeable then endo-ultrasound can be used to identify the gastric vessels and hence avoid these when subsequent incision through the gastric wall is made (Figs. 112.51, 112.52, and 112.53). The first step is to inject epinephrine into the gastric wall to prevent excessive hemorrhage following the use of the endo-knife or snare. Secondly, an incision can be made into the area where it is identified that the pseudocyst is juxtaposed to the gastric wall. This can be enlarged with a sphincterotome, and through this larger opening, pigtail cannulas can be introduced allowing drainage of the pseudocyst and subsequently prevention of closure of the fistula thus artificially created. Removal of these is not usually necessary. Symptomatic relief is usually immediate.

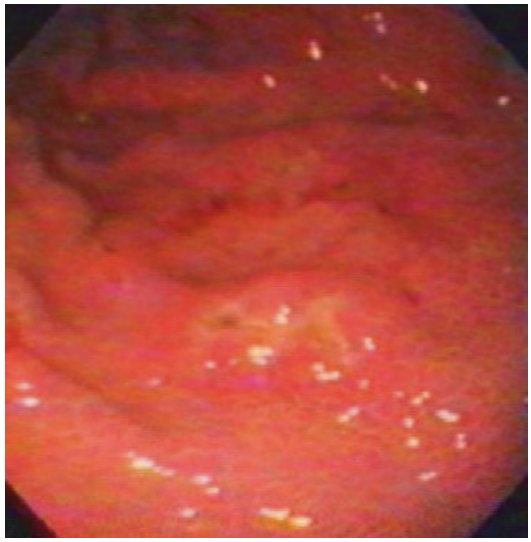

Fig. 112.45 Gastric erosion/ulcer

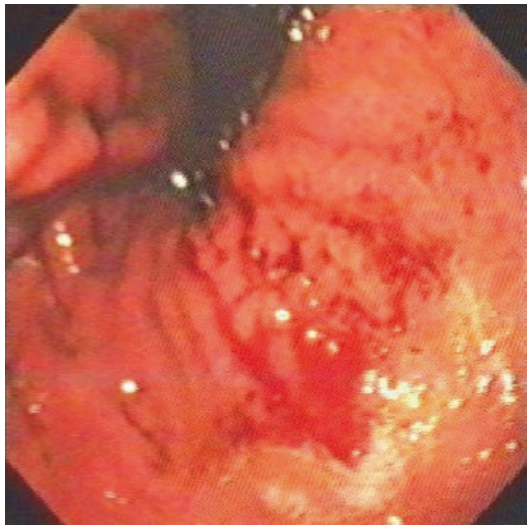

Fig. 112.46 Dieulafoy's lesion in fundus

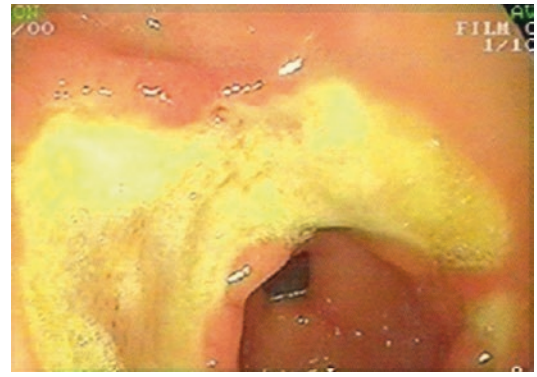

Fig. 112.47 Pre-pyloric ulcer crater with visible vessel

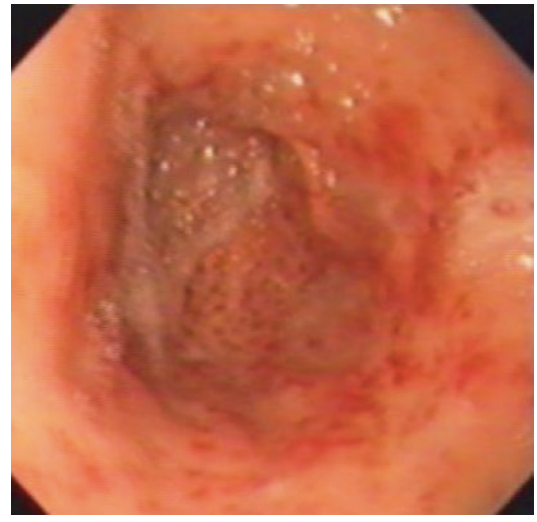

Fig. 112.48 GAVE (gastric antral vascular ectasia)

Anti-obesity Endotherapy

Balloons

The use of gastric balloons has not yet been properly explored in children or adolescents, but it has potential, especially in the medium-term accession of some weight loss, but may be not more than the initial satiety suppression that goes with gastric distension over the first few months post-insertion. Nevertheless, these devices may provide some initial inroad to weight loss, while other measures take a foothold, e.g., psychological, lifestyle management, dietary, exercise, and drug treatment (Fig. 112.54).

Endosleeve

This clever device is deployed from the duodenal cap endoscopically, and it essentially is anchored there by a self-expanding ring, which also allows subsequent endoscopic removal, and a plastic

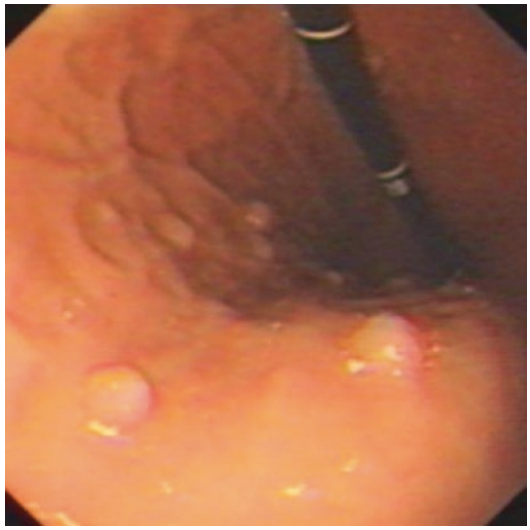

Fig. 112.49 Familial adenomatous polyposis in the stomach (FAP): incidental as do not bleed and do not undergo dysplasia

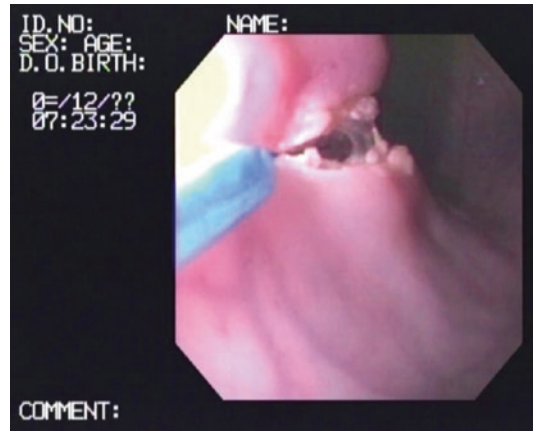

Fig. 112.51 Endo-knife incision through greater curvature of stomach into cyst, having injected adrenaline and employed endo-ultrasound to avoid gastric vessels

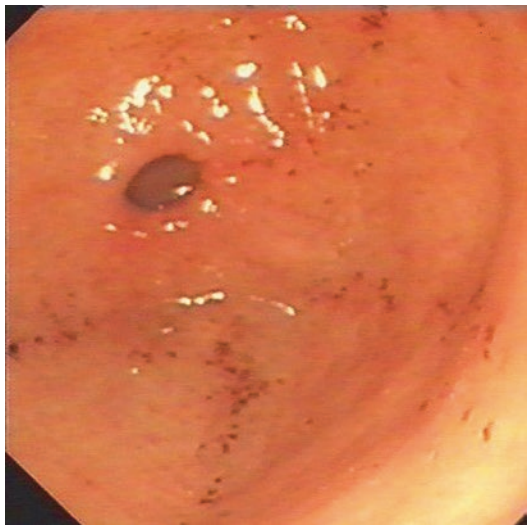

Fig. 112.50 Abrasion due to nasogastric tube tip

Fig. 112.52 Endoscopic view through gastric incision into cyst with a pigtail catheter evident

"sleeve" then is deployed distally preventing food absorption from the whole of the duodenum. It has been only used in adult studies, and its safety in children is not yet determined (Fig. 112.55).

StomaphyX

This is an endoscopic application which uses a new full-thickness plication technique by endoscopy, also used for creating a fundoplication endoscopically (EsophyX) at the GE junction, and pleats the stomach decreasing its

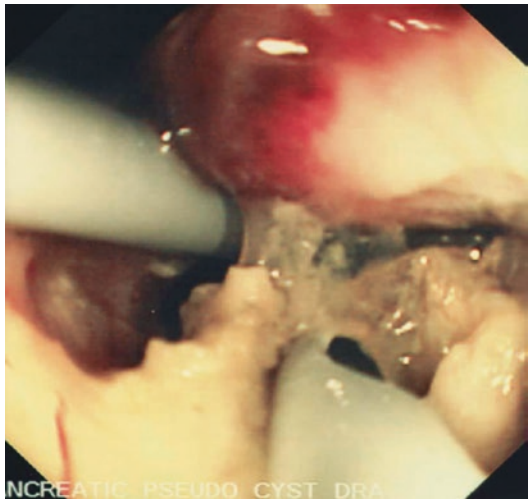

Fig. 112.53 Straight stents in situ into cyst from stomach

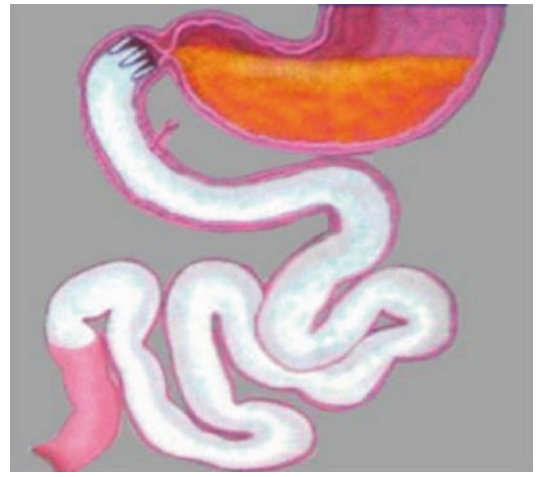

Fig. 112.55 Endosleeve preventing duodenal nutrient absorption

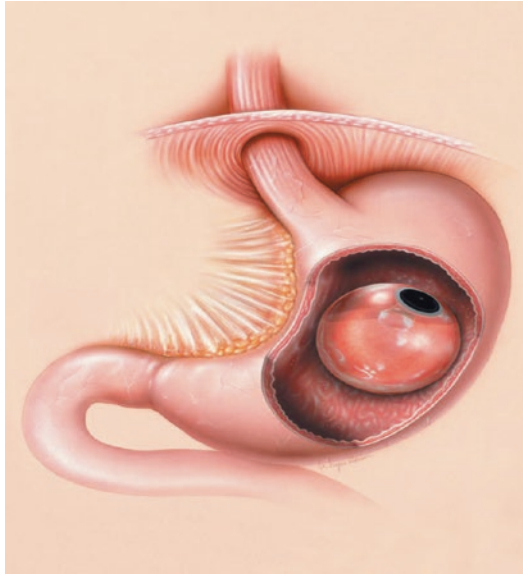

Fig. 112.54 Intragastric balloon

volume. It may be an adjunct to formal bariatric surgery, but again has not been applied in the pediatric age group (Fig. 112.56).

Endoscopic treatment of varices and NOTES are described and will not be delineated here.

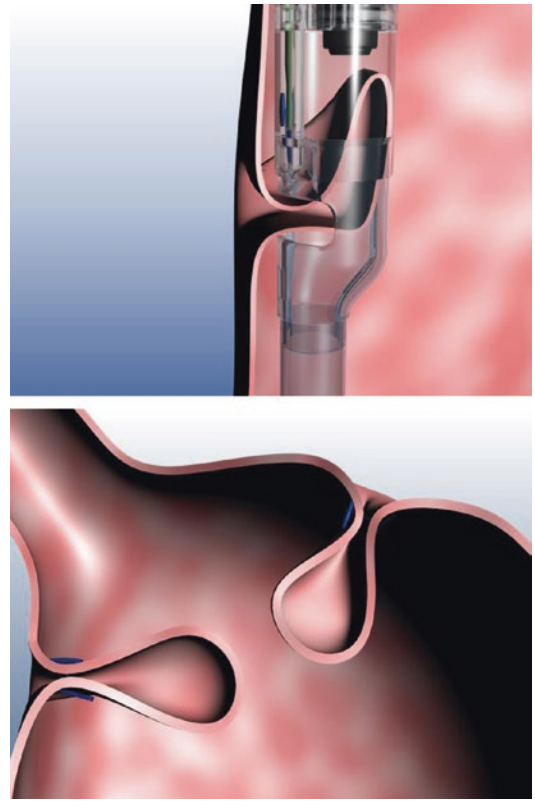

Fig. 112.56 Full-thickness transoral incisionless gastric volume diminution with StomaphyX

Summarizing, one would say that gastric endoscopy has turned the corner from diagnostic to therapeutic over the last few years and that the next decade or so may be viewed in retrospect as the time that gastroscopy came of age, mainly as a portal to natural orifice transendoluminal endoscopic surgery; however, this is still some way off.

References

1. Hassall E. Getting to grips with gastric pathology. J Pediatr Gastroenterol Nutr. 2002;34:S46–50.
2. Thomson M. Disorders of the oesophagus and stomach in infants. Bailliere's Clin Gastroenterol. 1997;11:547–71.
3. Winter H, Murphy M, Mougenot J-F, Cadranel S, editors. Pediatric gastrointestinal endoscopy. 2nd ed. NY, USA: BC Decker; 2006
4. Gershwin G, Amente A, Thomson M. Pediatric therapeutic endoscopy. NJ, USA: Wiley-Blackwell; 2011.
5. American Academy of Pediatrics Committee on Drugs. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. Pediatrics. 1992;89(6 Pt 1):1110–5.
6. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: addendum. Pediatrics. 2002;110:836–8.
7. Murphy MS. Sedation for invasive procedures in paediatrics. Arch Dis Child. 1997;77:281–4.
8. Bozzinin P. Lichtleiter, eine Enfindung zur Auschschauung innere Theieler und Krankheiten. J Pract Arzneykunde Wunderartzney kunst. 1806;24:107–24.
9. Desormeaux AJ. De l'Endoscopie, instrument propre a'ec lairer certaines cavities interieures de l'economie. Compte rendus de L'Acad Sci. 1855;40:692–3.
10. Nitze M. Beitrage zur Endoskopie der mannlichen Hamblase. Arch Klin Chir. 1887;36:661–732.
11. Mikulicz J. Uber Gastroskopie and Oesophagoskopie. Weiner Med Presse. 1896;33:298.
12. Schindler R. Gastroscopy with a flexible gastroscope. Am G Dig Dis Nutr. 1935;2:656.
13. Hirschowitz B, Peters CW, Curtis LE. Preliminary report on a long fiber scope for examination of stomach and duodenum. Mich Med Bull. 1957;23:178–80.
14. Thomson M, Kitching P, Jones A, Walker-Smith JA, Phillips A. Are endoscopic biopsies of small bowel as good as suction biopsies for diagnosis of enteropathy? J Pediatr Gastroenterol Nutr. 1999;29:438–41.
15. Thomson M, et al. Wireless capsule endoscopy in children: a study to assess diagnostic yield in small bowel disease in pediatric patients. J Pediatr Gastroenterol Nutr. 2007;44:192–7.
16. Sidhu R, McAlindon M, Sanders D, Ashok D, Thomson M. Capsule endoscopy and enteroscopy: modern modalities to investigate the small bowel in paediatrics. Arch Dis Child. 2008;93(2):154–9.
17. Thomson M, Venkatesh K, Elmalik K, Trotter M, van der Veer W, Jaacobs M. DBE in children:diagnosis, treatment, and safety. World J Gastroenterol. 2010; 16(1):56–62.
18. Castellaneta SP, Afzal NA, Greenberg M, Deere H, Davies S, Murch SH, Walker-Smith JA, Thomson M. Diagnostic role of upper gastrointestinal endoscopy in pediatric inflammatory bowel disease. J Pediatr Gastroenterol Nutr. 2004;39(3):257–61.
19. Venkatesh K, Cohen M, Shaw C, Tiffin N, Delaney P, Thomas S, Taylor C, Abutaleb A, Thomson M. Feasibility of confocal endomicroscopy in the diagnosis of paediatric gastrointestinal disorders: the first human studies in children. World J Gastroenterol. 2009;15:2214–9.
20. Andrus CH, Ponsky JL. Bezoars: classification, pathophysiology, and treatment. Am J Gastroenterol. 1988;83:476–8.
21. Pul N, Pul M. The Rapunzel syndrome (trichobezoar) causing gastric perforation in a child: a case report. Eur J Pediatr. 1996;155:18–9.
22. Wolfson PJ, Fabius RJ, Leibowitz AN. The Rapunzel syndrome: an unusual trichobezoar. Am J Gastroenterol. 1987;82:365–7.
23. Blam ME, Lichtenstein GR. A new endoscopic technique for the removal of gastric phytobezoars. Gastrointest Endosc. 2000;52:404–8.
24. Wang YG, Seitz U, Li ZL, Soehendra N, Qiao XA. Endoscopic management of huge bezoars. Endoscopy. 1998;30:371–4.
25. Kuo JY, et al. Nonoperative treatment of gastric bezoars using electrohydraulic lithotripsy. Endoscopy. 1999;31:386–8.
26. Huang YC, et al. Endoscopic lithotripsy of gastric bezoars using a laser-ignited mini-explosive device. Chin Med J (Engl). 1990;103:152–5.
27. Sechopoulos P, Robotis JF, Rokkas T. Gastric bezoar treated endoscopically with a carbonated beverage: case report. Gastrointest Endosc. 2004;60:662–4.
28. Ibarguen-Secchia E. Endoscopic pyloromyotomy for congenital pyloric stenosis. Gastrointest Endosc. 2005;61:598–600.
29. Gauderer MW, Ponsky JL, Izant Jr RJ. Gastrostomy without laparotomy: a percutaneous endoscopic technique. J Pediatr Surg. 1980;15:872–5.
30. Ponsky JL, Gauderer MW, Stellato TA. Percutaneous endoscopic gastrostomy. Review of 150 cases. Arch Surg. 1983;118:913–4.
31. Driver CP, Bruce J. An unusual cause of massive gastric bleeding in a child. J Pediatr Surg. 1997;32: 1749–50.
32. Wyllie R, Kay MH. Therapeutic intervention for non-variceal gastrointestinal hemorrhage. J Pediatr Gastroenterol Nutr. 1996;22:123–33.