Chapter 1
The Interface Between Therapeutic Gastrointestinal Endoscopy and Endoscopic Gastrointestinal Surgery

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Modern gastrointestinal endoscopy commenced with the development of flexible fiberoptic endoscopes in the 1950s [1]. Techniques soon developed which employed these instruments in the diagnostic evaluation of the upper and lower gastrointestinal tract. Flexible biopsy forceps were developed to permit the sampling of tissue. Originally these methods were performed by a single individual looking through the eyepiece of the endoscope. Soon after, fiberoptic teaching attachments were developed which attached to the instrument's eyepiece and permitted a second individual to observe the procedure simultaneously.

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The appreciation of abnormal tissue, particularly polyps in the colon, prompted the desire to develop a method for safely removing lesions. With the innovation of electrified metallic wire loops (snares), the technique of endoscopic polypectomy was born and began the era of therapeutic gastrointestinal endoscopy [2]. At the same time, creative endoscopists designed electrified wire probes to cauterize bleeding ulcers and injection needles to introduce sclerosants into esophageal varices. These same needles were used to introduce epinephrine to slow or stop bleeding lesions in the stomach and duodenum.

A major advance involved the development of the ability to access the papilla of Vater in the duodenum, thus adding an advanced means of evaluating biliary and pancreatic disease, endoscopic retrograde cholangiopancreatography (ERCP) [3]. In 1974, a therapeutic dimension was added to ERCP with the innovation of endoscopic sphincterotomy [4]. Now, with access to the bile duct, stones could be removed, tumors sampled, and stents inserted to relieve the obstruction. Similar interventions permitted access to the pancreatic duct.

In the esophagus, methods were developed to dilate strictures, stent tumors, and ablate Barrett's esophagus. More advanced techniques such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) permitted resection of premalignant and early malignant lesions.

The application of techniques used to treat hemorrhoidal veins was applied to the treatment of esophageal varices. This included the first injection of sclerosant solutions and then the use of band ligation [5]. The latter has become the standard methodology for eradicating varices and is easy to perform, safe, and effective.

An early minimally invasive surgical approach to obtaining enteral access for feeding was the development of a percutaneous endoscopic method (PEG) to establish a gastrostomy [6]. This approach was the first to cross the abdominal and intestinal walls to complement endoscopic therapy.

Endoscopic tools, though primitive, have been developed to treat gastroesophageal reflux; these have included injection techniques, suturing devices, and stapling machines. Thermal probes utilizing radiofrequency energy have been proven the best therapy for ablating dysplastic Barrett's mucosa [7].

In the early twenty-first century, innovative endoscopists conceptualized a technique that would permit intra-abdominal surgical procedures to be performed by means of translumenal access endoscopically via the stomach or colon [8]. Originally performed in animal models, the procedure was soon performed to remove the appendix in a human patient. The excitement generated was enormous and prompted the formation of a joint committee of surgeons and gastroenterologists, which was named NOSCAR (Natural Orifice Surgery Consortium for Assessment and Research), which would define parameters for research and practice of this innovation. The method itself was called NOTES, Natural Orifice Translumenal Endoscopic Surgery.

Under rigorous institutional review board (IRB) protocols, a number of procedures were studied, including transgastric cholecystectomy and appendectomy and a number of trans-colonic procedures. Unfortunately, due to a lack of effective instrumentation and failure to achieve economic parity with traditional techniques, the method was sidelined. There have been numerous outgrowths and clinical advancements because of this episode in endoscopic history, including the conceptualization and development of the intramural procedures such as POEM and POP, as well as full-thickness resection methods.

Evolving from curiosity and then a crucial diagnostic technology, endoscopic ultrasound (EUS) has become a major force in therapeutic endoscopy. Originally utilizing radial ultrasound, EUS was helpful in identifying abnormalities in the gut wall and adjacent structures. With the addition of linear ultrasound probes, endoscopists were able to perform therapy such as drainage of pseudocysts and pancreatic necrosis, as well as performing nerve blocks for palliation of pain.

More recently, with the advancement of stent technology permitting apposition of adjacent visceral walls, ultrasound technology has been used to drain obstructed gallbladders via the stomach or duodenum, debride large peri-pancreatic collections, and access the excluded stomach after Roux-en-Y bariatric surgery in order to perform ERCP [9].

More recently, directly as a result of work done to improve the NOTES procedures was the development of intramural surgery. In working to develop a tunneling method in the esophagus as an access method to the peritoneal cavity, investigators were able to visualize the esophageal musculature and conceived of a method to divide these muscles to treat achalasia [10]. First performed in animals, the method was initially performed in humans in Japan [11]. Termed Peroral Endoscopic Myotomy, POEM, the procedure rapidly gained popularity, was widely evaluated, and adopted worldwide. It has been shown to be effective in the treatment of achalasia and other muscular disorders of the esophagus. It has also led the way to other endoscopic maneuvers in this submucosal space, such as removal of benign tumors including leiomyomas and division of the cricopharyngeus muscle to treat Zenker's diverticulum. A further application of this intramural surgery has been the division of the pyloric muscle to treat gastroparesis. This method, termed peroral pyloromyotomy (POP) or G-POEM, involves the creation of a submucosal tunnel proximal to the pyloric ring, division of the ring with electrocautery, and clip closure of the mucosotomy [12].

It is clear that gastrointestinal endoscopy has evolved from a purely diagnostic technique, through the stage of endoscopic therapy for maladies of the intestinal lumen, to an access tool for the performance of surgical procedures on the gastrointestinal tract and adjacent organs.

Since the earliest days of flexible endoscopy, there has been debate over who should most appropriately perform these procedures. Gastroenterologists have argued that they are most appropriately suited to own this specialty, owing to their knowledge and capability to treat gastrointestinal dis-

eases. Certainly, the great majority of endoscopic procedures, predominantly upper and lower endoscopy and ERCP, are performed by gastroenterologists. Surgeons have argued that they have been instrumental in the development of most of the major therapeutic innovations in the field and, therefore should be involved in the performance of the procedures. Both are correct. To eliminate either group would diminish the field. Each specialty adds specific knowledge and perspective to the performance and development of endoscopy.

A review of the advances and refinements in gastrointestinal endoscopy will reveal the greatest progress has been achieved when both groups are involved and working cooperatively. Great efforts should be made to integrate training and research to achieve optimal quality of practice and advancement of innovation.

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