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Endoscopic full-thickness resection of upper gastrointestinal lesions

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ABSTRACT

Endoscopic full-thickness resection (EFTR) refers to the resection of a gastrointestinal (GI) lesion involving all layers of the endoluminal GI tract. These lesions may involve any layer of the GI tract. However, most EFTRs are performed for lesions that reach into the submucosa or deeper muscular layers. By definition, EFTR results in an orifice that exposes the GI luminal contents with the peritoneum or adjacent organs. Therefore, the defect must be tightly closed to prevent spillage of luminal contents outside the luminal GI tract. This closure can be achieved endoscopically with or without laparoscopic assistance, before or after the resection.

1. Introduction

The modern era of minimal invasive endoscopic surgery started when Hiromi Shinya performed the first endoscopic snare resection of a colon polyp in September 1969 [1]. Whereas polypectomy entailed the removal of a mucosal lesion, the concept of penetrating all layers of the gastrointestinal (GI) tract wall to accomplish an endoscopic intervention originated in the early 1980s, when the first transluminal feeding gastrostomy was performed by Gauderer et al [2]. A few years later Kozarek et al [3] reported on the successful endoscopic drainage of pancreatic pseudocysts and in 2004 Kalloo et al performed the first peroral peritoneoscopy in animals [4]. The concept of breaching all the layers of the GI tract to accomplish palliative and curative endoscopic therapeutic interventions thus became established [2-5]. Endoscopic full-thickness resection (EFTR) is further advancement in the concept of endoluminal surgery. One of the key developments in EFTR was the concept that transmural defects can be tightly closed using endoluminal or extraluminal devices such as clips, glues, loops, or a combination of 2 or more of these methods [6-11]. Indeed, one of the concepts that opened the way for EFTR was the closure of GI defects with clips to fix complications such as perforations [6-8]. Newer clips, devices, and techniques enabled the endoscopist to close larger defects [9-11]. A major development in this area has been the over-the-scope-clip system (OTSCs), which permits a controlled closure of larger defects [9-11]. It is important to emphasize that an important factor for the success of using such defect systems has been its use and experiment in biological and animal models before its application in humans [12-15].

The concept of performing endoluminal transmural endoscopic intervention is remarkable not only for its technical feasibility but also for its potential benefits, the biggest one being an "organ-sparing" approach. Whereas in the past the presence of an early cancer or a submucosal lesion almost always led to a resection of the entire or affected bowel, nowadays EFTR results in a localized resection of the tumor or lesion, leaving the entire organ intact [16-22]. Although the concept of EFTR requires the transection of GI wall with transluminal free opening (access) to the peritoneal cavity this approach did not evolve from natural orifice transluminal endoscopic surgery (NOTES) [4,5,18,23]. Indeed, NOTES was developed with a completely different goal in mind: to perform intraperitoneal or retroperitoneal surgical interventions through the GI lumen, thus avoiding skin incisions [4,5,18,23,24]. Nevertheless, there are 3 very important aspects that are common to NOTES and EFTR, which include (1) safe closure of the wall defect, (2) the physiological consequence of free air in the peritoneal cavity, and (3) the possibility of tumor seeding [16-24].

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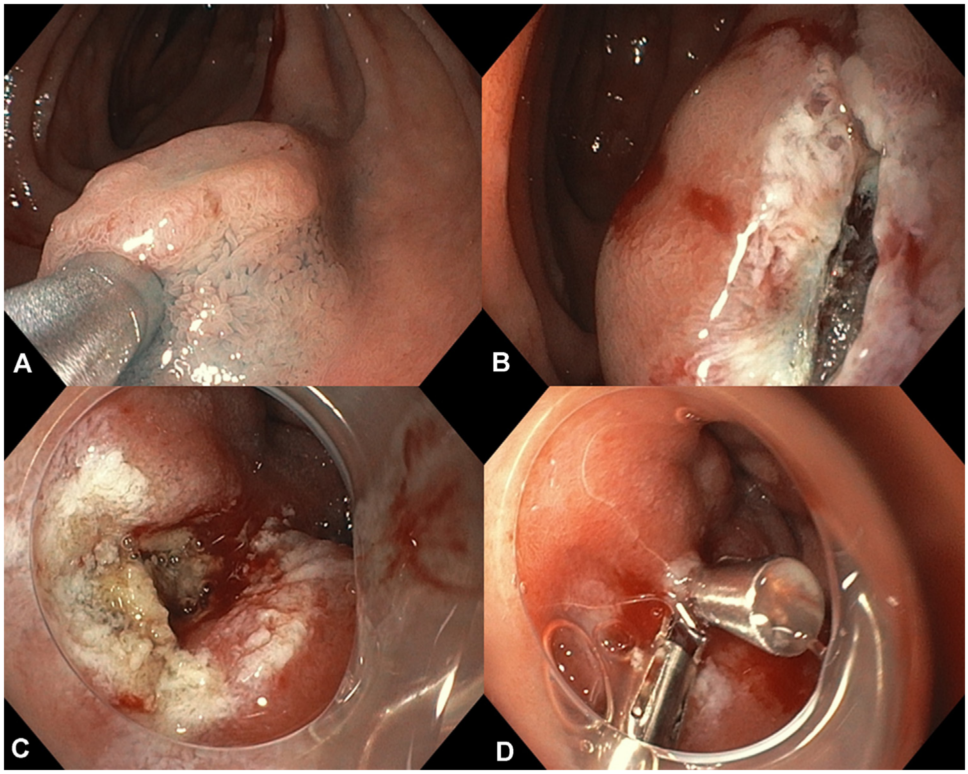

Fig. 1. Principles of endoscopic resection. (A) One of the most important steps in endoscopic resection is to create a submucosal cushion. (B) A circumferential incision is made using the tip of a snare or a knife. (C) When a submucosal lesion is resected, the defect is deep. (D) Usually, small defects can be closed with standard clips.

2. Closure of endoluminal GI defects

The most important step to accomplish an EFTR is the ability to close the GI defect. The concept of endoscopic closure of GI defects originated as response to endoscopic complications such as perforations and fistulas [6,7]. Traditionally, surgical treatment was the standard approach to treat iatrogenic perforation during endoscopic procedures [6,7,25,26]. However, in at least 50% of cases, perforations can be managed immediately with the application of endoclips, insertion of fully covered metal stents, endoloops, endosponge, and application of sealants (glue) [6-10]. The size of the defect, location, and spillage of GI luminal contents, the use of carbon dioxide for interventional procedure, and individual (local) expertise are circumstances that influence the decision to proceed with endoscopic closure [6,7]. Nowadays it is possible to repair perforations even larger than a few centimeters by sealing the defect with omentum and securing it with multiple endoclips or OTSC [9,10,11,19] (Figures 1 and 2). However, severe delayed complications still often require surgical repair or intensive care and can even be fatal.

The ability to close full-thickness defects led endoscopists to think "outside the box" and approach the concept of EFTR of epithelial and subepithelial GI lesions as being feasible and reproducible [16,17,19].

3. Spectrum of endoscopic resection methods

Endoscopic resection comprises 5 main types of techniques: (1) endoscopic mucosal resection (EMR), (2) endoscopic submucosal dissection (ESD), (3) endoscopic submucosal tunneling, (4) endoscopic enucleation, and (5) EFTR [27-30] (Figures 1 and 3).

Whereas EMR is minimally invasive standard of practice for epithelial lesions, ESD and enucleation can be used to remove both epithelial and subepithelial tumors that originate or expand as deep as the muscularis propria [21,31]. The techniques of ESD and enucleation were invented and mastered in Japan and have gained in popularity over time. These techniques result in en bloc and complete (R0) resection of larger lesions [32,33]. ESD is now an accepted endoscopic resection technique and is performed by experts around the world. However, owing to challenges with training in ESD, technical difficulties, long procedure times, and an increased rate of complications, ESD is not always possible. In addition, in some cases, ESD treatment alone is insufficient for disease control, and laparoscopic surgery is required [34]. Moreover, the major limitation of ESD as a curative treatment is inability to assess lymph node status that is usually performed by computed tomography or endoscopic ultrasound (EUS) with variable accuracy [35].

For these reasons laparoscopic wedge resection was developed as a minimally invasive treatment modality [36]. However, laparoscopic wedge resection can create a larger resection than expected, and may lead to gastric stenosis or deformity [37]. To overcome this problem and minimize the invasiveness, the next step was the development of hybrid technique that uses ESD in combination with laparoscopic sentinel node resection, or laparoscopic closure of the ESD defect [38].

EFTR in combination with or without laparoscopic surgery has become the focus of interest challenging the current practice [22]. Despite its advantages, the procedure is demanding and may require conversion to classic surgical procedure. In addition, cancer cells may seed the peritoneal cavity [19-23].

4. Endoscopic full-thickness resection

EFTR entails the intent of complete removal of a lesion originating in any layer of the GI tract wall by endoscopic means