Communication from the ASGE Technology Committee

TECHNOLOGY STATUS EVALUATION REPORT

Endoscopic mucosal resection

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The ASGE Technology Committee provides reviews of existing, new, or emerging endoscopic technologies that have an impact on the practice of GI endoscopy. Evidence-based methodology is used, by using a MEDLINE literature search to identify pertinent clinical studies on the topic and a MAUDE (U.S. Food and Drug Administration Center for Devices and Radiological Health) database search to identify the reported adverse events of a given technology. Both are supplemented by accessing the "related articles" feature of PubMed and by scrutinizing pertinent references cited by the identified studies. Controlled clinical trials are emphasized, but in many cases, data from randomized, controlled trials are lacking. In such cases, large case series, preliminary clinical studies, and expert opinions are used. Technical data are gathered from traditional and Web-based publications, proprietary publications, and informal communications with pertinent vendors. For this review, the MEDLINE database was searched for publications in English through September 2014 by using the keywords "endoscopic lesion removal," "endoscopic resection," "endoscopic mucosal resection," and "EMR."

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BACKGROUND

EMR was developed for minimally invasive, organ-sparing endoscopic removal of benign and early malignant lesions in the GI tract. This report focuses on instruments, injection solutions, and techniques currently used for EMR. This report is an update of a previous Technology Status Evaluation Report titled "Endoscopic Mucosal Resection and Endoscopic Submucosal Dissection."[1] The topic of endoscopic submucosal dissection (ESD) is now discussed in a separate Technology Status Report.[2]

TECHNOLOGY UNDER REVIEW: EMR

EMR is an endoscopic technique developed for the removal of sessile or flat neoplasms confined to the superficial layers (mucosa and submucosa) of the GI tract. The commonly used techniques can be categorized as injection-, cap-, and ligation-assisted EMR. Underwater EMR is a newer technique that is useful, particularly for salvage EMR.

Proper patient and lesion selection for EMR with endoscopic and/or endosonographic evaluations is essential. Before the start of any EMR procedure, close visual inspection to delineate the margins, particularly of flat lesions, is imperative because manipulation of the lesion may obscure landmarks. It may be helpful to mark the margins of the targeted lesion with superficial cautery marks with the tip of a snare or with argon plasma coagulation (APC). Electrosurgical unit settings for polypectomy and EMR are discussed in a previous Technology committee document.[3] A retrieval device may then be used to retrieve EMR specimens.

Injection-assisted EMR

Injection-assisted EMR is also often called saline solution lift–assisted polypectomy. This technique was introduced in 1955 for rigid sigmoidoscopy and then in 1973 for flexible colonoscopy.[4,5] The procedure starts with injection of

a solution into the submucosal space under the lesion creating a safety cushion. The cushion lifts the lesion, facilitating capture and removal by using a snare while minimizing mechanical or electrocautery damage to the deeper layers of the GI wall. The lesion may be removed in a single resection or a piecemeal fashion.

Cap-assisted EMR

Cap-assisted EMR also uses submucosal injection to lift the target mucosal lesion. Dedicated mucosectomy devices have been developed that use a cap affixed to the tip of the endoscope (EMR Kit; Olympus America Inc, Center Valley, Pa) (Table 1).[6] These single-use devices come equipped with a specially designed crescent-shaped electrocautery snare that must be opened and positioned on the internal circumferential ridge at the tip of the cap (Fig. 1). The endoscope is then immediately positioned over the target lesion, and suction is used to retract the mucosa into the cap after which the snare is closed to capture the lesion. The lesion is then resected with standard snare excision technique by using electrocautery. The available cap-assisted mucosectomy devices differ primarily in the characteristics of the cap. Caps are composed of clear plastic, which may be soft or hard. The caps are cylindrical and available with a flat circular (straight)– or oval (oblique)–shaped tip, both with outer diameters ranging from 12.9 to 18 mm.

Ligation-assisted EMR

In ligation-assisted EMR, a band ligation device (Duette Multi-Band Mucosectomy device, Cook Medical Inc., Winston-Salem, NC) is attached to the endoscope, and the banding cap is positioned over the target lesion with or without previous submucosal injection. Suction is applied to retract the lesion into the banding cap, and a band is deployed to capture the lesion, thereby creating a pseudopolyp. An electrocautery snare is then used to resect the pseudopolyp above or below the band.[7,8] The handle of the EMR band ligator allows insertion and advancement of a snare device through the endoscope working channel without requiring removal of the banding apparatus. The kit also includes a 1.5 × 2.5-cm hexagonal braided electrocautery snare available with a 5F (for diagnostic endoscopes) or 7F (for therapeutic endoscopes) insertion sheath. In addition, the band ligation device incorporates 6 bands, allowing potential resection at as many as 6 mucosal sites without the need to change the device. Two sizes of ligating caps are available to fit endoscopes with outer diameters of 9.5 to 13 mm and 11 to 14 mm.

Underwater EMR

In the underwater EMR (UEMR) technique, luminal air is suctioned, and water is instilled to fill the GI lumen and immerse the target lesion. Water immersion allows lesion visualization without over distention of the GI tract wall. It is postulated to "float" the mucosa and submucosa away from the deeper muscularis propria layer and allows EMR without requiring submucosal injection.[9] This technique has the theoretical advantages of eliminating any risk of tracking neoplastic cells into deeper layers of the GI tract wall by the injection needle and making capture of flat lesions easier. This method has also been reported to be effective in managing recurrences after previous EMR, as well as patients with previous partial resections and biopsies of lesions[10] because these interventions may result in submucosal fibrosis, making lifting of the lesion with submucosal injection difficult.[11-18]

Adjunctive techniques

Additional ablative techniques are used in an organ-specific manner in addition to EMR for the ablation of residual tissue. In the esophagus, radiofrequency or cryoablation is frequently used to ablate additional Barrett's esophagus after EMR of the dysplastic lesions. During resection of flat adenomas in the GI tract, APC or the use of hot biopsy forceps (also known as the hot avulsion technique) may be used to ablate residual adenomatous tissue at the base and edges of the resection site.[13,19-22] However, the application of APC to ablate residual adenomatous tissue was associated with a higher risk of adenoma recurrence.[23] Use of the snare tip with soft coagulation for residual tissue that cannot be removed by snare resection in the colon is currently being evaluated in a randomized, controlled trial.

Specimen handling

Because EMR specimens are larger than biopsy samples, it is helpful for pathologic interpretation to orient and mount the specimen before submerging it in fixative. The specimen is often pinned onto a paraffin wax block and fully submerged in fixative before transporting the specimen to pathology. A paraffin wax block is beneficial because it will not float in fixative.

Submucosal injection solutions

Although submucosal injection is not essential for all EMR procedures, it is an integral part of injection-assisted EMR. Various solutions have been used for submucosal injection (Table 2). The ideal agent should be inexpensive, readily available, nontoxic, easy to inject, and provide a long-lasting submucosal cushion.[24,25] Normal saline solution is widely available and often used for injection-assisted EMR. However, a cushion made with normal saline solution often dissipates within minutes. Multiple studies have demonstrated longer lasting cushions made with various agents including hyaluronic acid (HA), hydroxypropyl methylcellulose (HPMC), succinylated gelatin, glycerol, and a fibrinogen solution.[26-32] Currently, there are no injection solutions that are specifically approved for EMR by the U.S. Food and Drug Administration; therefore, all solutions mentioned in this document would be considered off-label. A 0.4% solution of HA is approved as an injection solution for