



Core curriculum for endoscopic mucosal resection

Prepared by: ASGE TRAINING COMMITTEE

Hiroyuki Aihara, MD, PhD, FASGE,¹ Vladimir Kushnir, MD, FASGE,² Gobind S. Anand, MD,³ Lisa Cassani, MD,⁴ Prabhleen Chahal, MD,⁵ Sunil Dacha, MD,⁶ Anna Duloy, MD,⁷ Sahar Ghassemi, MD,⁸ Christopher Huang, MD,⁹ Thomas E. Kowalski, MD,¹⁰ Emad Qayed, MD,¹¹ Sunil G. Sheth, MD, FASGE,¹² C. Roberto Simons-Linares, MD,⁵ Jason R. Taylor, MD,¹³ Sarah B. Umar, MD,¹⁴ Stacie A. F. Vela, MD, FASGE,¹⁵ Catharine M. Walsh, MD, MEd, PhD,¹⁶ Renee L. Williams, MD,¹⁷ Mihir S. Wagh, MD, FASGE (Chair, ASGE Training Committee)⁷

This is one of a series of documents prepared by the American Society for Gastrointestinal Endoscopy Training Committee. This document contains recommendations for a training curriculum intended for use by endoscopy training directors, endoscopists involved in teaching endoscopy, and trainees in endoscopy. It was developed as an overview of techniques currently favored

for the performance and training for endoscopic mucosal resection (EMR) and to serve as a guide to published references, videos, and other resources available to the trainer.

Acquiring the skills to perform EMR requires a thorough understanding of the histology and pathology of the GI tract and indications, technical performance, risks, and limitations of the techniques. Trainees should be experienced in upper endoscopy, colonoscopy with polypectomy, and hemostasis before pursuing training in EMR.¹⁻³ Trainees should also be knowledgeable in management of potential adverse events that may occur involving these procedures, such as bleeding (clipping, injection, and thermal treatment), perforation (closure with clips or other devices), and stricture formation (dilation and temporary stent placement).⁴ Specifics on quality metrics and competency assessment are separate topics that are not the focus of this curriculum. The core technical, nontechnical, and cognitive skills necessary for training EMR are shown in [Table 1](#).

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 band ligation-assisted EMR.⁵ Underwater EMR is a newer technique to remove difficult-to-resect lesions.^{6,7} Avulsion is a technique to remove small residual neoplastic tissue with a hot or cold biopsy forceps.⁸ Endoscopic submucosal dissection (ESD) is a newer technique for endoscopic resection and is a separate topic not covered in this text.

GOALS OF TRAINING

On completion of training, trainees should be prepared to appropriately recommend EMR, as indicated by the findings of endoscopic evaluation, and perform these procedures safely and completely. They should be able to recognize and appropriately manage adverse events when they occur,

Copyright © 2020 by the American Society for Gastrointestinal Endoscopy
0016-5107/\$36.00

<https://doi.org/10.1016/j.gie.2020.06.053>

Received June 19, 2020. Accepted June 19, 2020.

Current affiliations: Division of Gastroenterology, Hepatology and Endoscopy, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA (1), Division of Gastroenterology, John T. Milliken Department of Medicine, Washington University School of Medicine in St. Louis, St. Louis, Missouri, USA (2), Division of Gastroenterology, University of California San Diego, San Diego, California, USA (3), Department of Medicine, Division of Digestive Diseases, Emory University School of Medicine, and Atlanta VA Medical Center, Atlanta, Georgia, USA (4), Digestive Disease and Surgery Institute, Cleveland Clinic, Ohio, USA (5), Division of Gastroenterology, Department of Internal Medicine, Houston Methodist Hospital and Texas A&M University, Houston, Texas, USA (6), Division of Gastroenterology, University of Colorado-Denver, Aurora, Colorado, USA (7), Division of Gastroenterology and Hepatology, Duke University, Durham, North Carolina (8), Section of Gastroenterology, Department of Medicine, Boston University School of Medicine, Boston, Massachusetts, USA (9), Division of Gastroenterology and Hepatology, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA (10), Department of Medicine, Division of Digestive Diseases, Emory University School of Medicine, Atlanta, Georgia, USA (11), Division of Gastroenterology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA (12), Department of Internal Medicine, Division of Gastroenterology and Hepatology, Saint Louis University, St Louis, Missouri, USA (13), Division of Gastroenterology Mayo Clinic Arizona, Scottsdale, Arizona, USA (14), Gastroenterology Section, Phoenix VA Health Care System, University of Arizona-Phoenix, Phoenix, Arizona (15), Division of Gastroenterology, Hepatology and Nutrition and the Research and Learning Institutes, Hospital for Sick Children, Department of Paediatrics and the Wilson Centre, University of Toronto, Toronto, Canada (16), Department of Medicine, Division of Gastroenterology, NYU Grossman School of Medicine, New York, New York, USA (17).

TABLE 1. Core technical, nontechnical, and cognitive skills necessary for training in EMR

Technical	Nontechnical	Cognitive
<ul style="list-style-type: none"> • Evaluate relation of the lesion to important landmarks (eg, gastroesophageal junction, ampulla, ileocecal valve, and anal verge) • Evaluate extent of lesion and depth of invasion with mucosal enhancement technology (eg, chromoendoscopy, narrow-band imaging, blue-light imaging) and/or EUS and mark, if necessary • Inject lifting solution into the submucosal layer • Adjust the size and angle of the snare so the target area is entirely grasped • Carefully inspect the resection bed and mucosal edge for possible residual lesions, muscle injury, and visible vessels • Close the mucosal defect in selected cases after EMR • Use a retrieval net to collect specimens • Carefully inspect the specimen for a possible target sign 	<ul style="list-style-type: none"> • Communicate effectively with the patient and other consulting services (eg, surgery and oncology) as part of a multidisciplinary team • Obtain consent by explaining the risks and benefits of the procedure and expected outcomes • Evaluate the patient's cardiovascular risk and fitness for upper or lower endoscopy, in consultation with anesthesia specialists in selected cases • Select the appropriate treatment technique depending on the size, location, and appearance of lesions • Communicate effectively with the endoscopy assistant during the procedure • Generate a detailed procedure report with accurate description of interventions and type of devices used 	<ul style="list-style-type: none"> • Understand indications and contraindications for EMR for both dysplastic and superficial malignant lesions • Understand appropriate settings for the electrosurgery generator • Know available sizes and stiffness of snares • Understand the efficacy of different types of lifting solutions, caps, and clips • Know the appropriate postprocedure care of patients after EMR (diet, anticoagulation, and follow-up) • Know signs and symptoms of adverse events (perforation, bleeding, stricture, and postpolypectomy syndrome)

acknowledge the limitations of EMR and personal skills, know when to request help, and understand the principles of quality measurement and improvement.^{9,10} Trainees should be familiar with the appropriate management of anticoagulation in the setting of a mucosal resection, taking into consideration the potential risk of delaying reinitiation of anticoagulants or antiplatelet agents.¹¹ Additionally, trainees need to clearly communicate findings, treatment performed, postprocedure instructions, and follow-up recommended to the patient and family and to communicate to the referring and primary physicians.

Trainees should be taught to obtain informed consent and explain all potential adverse events of the specific procedure being recommended, including the advantages and disadvantages of the procedure when compared with other management options. Trainees must understand the risks and benefits of various EMR techniques, know when to consider newer techniques such as ESD, and provide the patient with a tailored risk assessment and informed consent.

Additionally, all trainees should work closely with pathology services and understand GI tumor staging. Understanding the importance of the relationship between neoplastic tissue and the lateral and deep margins is critical in deciding if further surgical or medical therapy is indicated. The pattern and risk of lymph node involvement with superficial tumors in different anatomic locations should be understood by all trainees. Counseling of patients and their families will rely heavily on the understanding of the pathology of the lesions.

Faculty

In general, teaching faculty should not only be experienced endoscopists who are committed to the entire

training process but also facile in the skills involved in EMR. Programs need to ensure that an adequate number of such individuals are available to ensure optimal teaching. The faculty member must be dedicated to teaching these advanced procedures and have time available to instruct and evaluate the trainees.

Facilities

Institutions that provide advanced training should have the capability for mucosal enhancement technology (eg, high-definition endoscopy, narrow-band imaging, blue-light imaging, chromoendoscopy). Training institutions do not need to have all EMR techniques available, but trainees should be aware of the available techniques and modalities and the literature supporting each.

ENDOSCOPIC EXPERIENCE

EMR involves the removal of dysplastic or superficial malignant lesions within the gastrointestinal lumen.^{5,12-15} Trainees should know the appropriate indications for EMR and the appropriate staging before performing these procedures. Some lesions may be more amenable to resection using ESD. Understanding differences in these techniques is important to properly manage these lesions.¹⁶

Trainees should be fully aware of the limitations of mucosal resection in different parts of the GI tract. Trainees need to be able to assess and classify the lesion requiring EMR according to the Paris classification,¹⁷ pit pattern classification,¹⁸ and Narrow-Band Imaging International Colorectal Endoscopic classification¹⁹ based on the findings from high-definition endoscopy and mucosal enhancement technology. The assessment should include

recognition of lesions that are not amenable to EMR, including findings that suggest unresectability that may be discovered during the procedure.

Furthermore, marking the area to be resected using thermal marking or other approaches should be taught. Trainees should understand and be able to perform 1 or more of the various techniques currently used for EMR. Trainees should know the advantages of the available distal endoscopic attachments, such as oblique and straight caps, in various GI tract organs. Trainees should be taught appropriate electrosurgery settings and how to change the settings based on the morphologic types of the lesion and resultant tissue effect.

EMR in the esophagus

Cap- and band ligation–assisted EMR are often used in esophageal EMR. Trainees should know how to set up the EMR kit before the procedure and understand differences between the 2 techniques. In cap-assisted EMR, submucosal injection is performed first, and a crescent-shaped snare is opened and positioned in the internal circumferential groove of the cap. The target lesion is then suctioned into the cap and removed using a hot snare. In band ligation–assisted EMR (multiband mucosectomy), the target lesion is first suctioned into the cap to create a pseudopolyp without submucosal injection and then resected with a hot snare. Trainees should understand these important steps in both procedures and how to strategically perform step-by-step resections to achieve complete removal of the lesion.²⁰

EMR in other organs

Injection-assisted EMR is typically used for removal of gastric, duodenal, and colorectal neoplasms. Trainees should learn dynamic submucosal injection and to strategically perform serial submucosal injections to lift the mucosa before EMR. They should understand the advantages and disadvantages of the available mucosal-lifting solutions²¹ as well as the potential advantages of underwater EMR in difficult-to-lift lesions. In underwater EMR, the target lesion is submerged with instillation of water and the lesion then removed with a hot snare without submucosal injection. Trainees should understand the benefit of this method, especially for removal of recurrent lesions.⁶

Hemostasis, defect closure, and specimen retrieval after EMR

Trainees should learn to evaluate the resection site for evidence of large vessels that may require prophylactic treatment and to assess whether there is evidence for perforation. Trainees should be able to use hemostatic forceps to stop active bleeding and to cauterize visible vessels to prevent delayed bleeding. Trainees should learn how to effectively perform the snare tip soft coagulation of

exposed blood vessels and at the resection edges when performing wide-field EMR.²² Regardless of the type of EMR technique used, trainees should learn mucosal defect closure techniques, if needed, to prevent delayed bleeding. Familiarity with the various types of retrieval devices used to capture the resected specimen(s) should be achieved. Trainees should also know the options for managing residual neoplastic tissue using snare, argon plasma coagulation, hot biopsy forceps, and other adjunctive techniques. Trainees should coordinate and communicate with their pathology services to ensure appropriate handling of specimens and proper processing.

Trainees should understand resection outcomes based on pathologic findings and risk of lymph node involvement with superficial tumors in different anatomic locations. They should comprehend definitions of en bloc resection, complete resection, and curative resection and when to consider further oncologic treatments. Trainees should also be able to advise appropriate surveillance after EMR.

SUMMARY

This core curriculum for EMR is meant to serve as a platform for education, training, and practice. By providing information to endoscopy trainers about the common practices used by experts in these techniques, the American Society for Gastrointestinal Endoscopy hopes to improve the teaching and performance of EMR.

DISCLOSURES

The following authors disclosed financial relationships: H. Aihara: Consultant for Boston Scientific, Fujifilm Medical Systems USA, Inc, Olympus America Inc, Medtronic USA Inc, Auris Health Inc, Lumendi, and 3-D Matrix Inc. V. Kushnir, T. E. Kowalski: Consultant for Boston Scientific Corporation and Medtronic USA, Inc. J. R. Taylor: Consultant for AbbVie. R. L. Williams: Stockholder with Boston Scientific Corporation. M. S. Wagh: Consultant for Boston Scientific, Incyte Corporation, Medtronic, and Olympus America Inc. All other authors disclosed no financial relationships.

REFERENCES

1. Waschke KA, Coyle W. Advances and challenges in endoscopic training. *Gastroenterology* 2018;154:1985-92.
2. ASGE Training Committee; Sedlack RE, Coyle WJ, Obstein KL, et al. ASGE's assessment of competency in endoscopy evaluation tools for colonoscopy and EGD. *Gastrointest Endosc* 2014;79:1-7.
3. Accreditation Council for Graduate Medical Education (ACGME); ACGME program requirements for graduate medical education in gastroenterology (internal medicine): 2020. Available at: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/144_Gastroenterology_2020.pdf?ver=2020-06-29-161609-117 Accessed July 22, 2020.

4. ASGE Standards of Practice Committee; Faulx AL, Lightdale JR, Acosta RD, et al. Guidelines for privileging, credentialing, and proctoring to perform GI endoscopy. *Gastrointest Endosc* 2017;85:273-81.
5. ASGE Training Committee; Hwang JH, Konda V, Abu Dayyeh BK, et al. Endoscopic mucosal resection. *Gastrointest Endosc* 2015;82:215-26.
6. Binmoeller KF, Shah JN, Bhat YM, et al. "Underwater" EMR of sporadic laterally spreading nonampullary duodenal adenomas (with video). *Gastrointest Endosc* 2013;78:496-502.
7. Tanaka S, Kashida H, Saito Y, et al. JGES guidelines for colorectal endoscopic submucosal dissection/endoscopic mucosal resection. *Dig Endosc* 2015;27:417-34.
8. Holmes I, Kim HG, Yang DH, et al. Avulsion is superior to argon plasma coagulation for treatment of visible residual neoplasia during EMR of colorectal polyps (with videos). *Gastrointest Endosc* 2016;84:822-9.
9. Freeman ML. Training and competence in gastrointestinal endoscopy. *Rev Gastroenterol Disord* 2001;1:73-86.
10. Oversight Working Network; Rose S, Fix OK, et al. Entrustable professional activities for gastroenterology fellowship training. *Gastrointest Endosc* 2014;80:16-27.
11. ASGE Standards of Practice Committee; Acosta RD, Abraham NS, Chandrasekhara V, et al. The management of antithrombotic agents for patients undergoing GI endoscopy. *Gastrointest Endosc* 2016;83:3-16.
12. Sharma P. Clinical practice. Barrett's esophagus. *N Engl J Med* 2009;361:2548-56.
13. American Gastroenterological Association; Spechler SJ, Sharma P, et al. American Gastroenterological Association medical position statement on the management of Barrett's esophagus. *Gastroenterology* 2011;140:1084-91.
14. Moss A, Williams SJ, Hourigan LF, et al. Long-term adenoma recurrence following wide-field endoscopic mucosal resection (WF-EMR) for advanced colonic mucosal neoplasia is infrequent: results and risk factors in 1000 cases from the Australian Colonic EMR (ACE) study. *Gut* 2015;64:57-65.
15. Perez-Cuadrado-Robles E, Queneherve L, Margos W, et al. Comparative analysis of ESD versus EMR in a large European series of non-ampullary superficial duodenal tumors. *Endosc Int Open* 2018;6:E1008-14.
16. ASGE Technology Committee; Maple JT, Abu Dayyeh BK, Chauhan SS, et al. Endoscopic submucosal dissection. *Gastrointest Endosc* 2015;81:1311-25.
17. The Paris endoscopic classification of superficial neoplastic lesions: esophagus, stomach, and colon: November 30 to December 1, 2002. *Gastrointest Endosc* 2003;58:S3-43.
18. Huang Q, Fukami N, Kashida H, et al. Interobserver and intra-observer consistency in the endoscopic assessment of colonic pit patterns. *Gastrointest Endosc* 2004;60:520-6.
19. Hayashi N, Tanaka S, Hewett DG, et al. Endoscopic prediction of deep submucosal invasive carcinoma: validation of the Narrow-Band Imaging International Colorectal Endoscopic (NICE) classification. *Gastrointest Endosc* 2013;78:625-32.
20. Pouw RE, van Vilsteren FG, Peters FP, et al. Randomized trial on endoscopic resection-cap versus multiband mucosectomy for piecemeal endoscopic resection of early Barrett's neoplasia. *Gastrointest Endosc* 2011;74:35-43.
21. Repici A, Wallace M, Sharma P, et al. A novel submucosal injection solution for endoscopic resection of large colorectal lesions: a randomized, double-blind trial. *Gastrointest Endosc* 2018;88:527-35.
22. Fahrtash-Bahin F, Holt BA, Jayasekera V, et al. Snare tip soft coagulation achieves effective and safe endoscopic hemostasis during wide-field endoscopic resection of large colonic lesions (with videos). *Gastrointest Endosc* 2013;78:158-63.