

“HOW I DO IT”

Endoscopic mucosal resection (EMR) in the esophagus



Horst Neuhaus, MD

Department of Internal Medicine

Evangelisches Krankenhaus Düsseldorf, Germany

Indications

Endoscopic mucosal resection (EMR) should be considered in patients with early esophageal neoplastic lesions, provided that these are not associated with lymph node metastasis. The risk mainly depends on the depth of tumor infiltration. According to Japanese studies of esophagectomy specimens, the incidence of lymph node metastasis is less than 2% if squamous cell cancer (SCC) is limited to the upper or mid layer of the mucosa (T1m1–2). Comparable data were reported from western countries for early Barrett's adenocarcinoma. In addition EMR is a promising technique for removal of high grade intraepithelial neoplasia (HGIN) to prevent the progress to cancer which will otherwise occur in every third patient within a few years. In contrast to ablative techniques, EMR has the advantage of providing a specimen for histopathological diagnosis. Compared with biopsy studies this approach reveals more advanced tumor stages in terms of grading and vertical neoplastic infiltration in 10%–20% of patients. In the case of submucosal invasion, esophagectomy is indicated because of the risk of lymph node metastasis. In contrast, complete resection of SCC or Barrett's adenocarcinoma/HGIN limited to the mucosa can be considered as a definitive treatment. Close follow-up is required for early diagnosis and treatment of residual, recurrent, or metachronous neoplastic lesions.

Because of the importance of histopathological diagnosis, we consider EMR for all suspicious lesions when biopsy studies have revealed HGIN or early adenocarcinoma, provided that they fulfil the criteria of early neoplasia (type 0) in the Paris classification. Endoscopic ultrasound (EUS) is performed prior to EMR to exclude pathological lymph nodes. We do not use high frequency EUS for discrimination between mucosal and submucosal tumor infiltration because of its limited accuracy. The best candidates for EMR are patients with a small area of early SCC or focal lesion in a short-segment Barrett's esophagus. In these cases surveillance of non-neoplastic areas after EMR is easy, or EMR can be used for complete eradication of Barrett's epithelium. Widespread EMR or total removal of



Barrett's epithelium is required in patients with multifocal lesions. This approach is technically more challenging in long segments and is associated with a considerable risk of esophageal stricture formation. As an alternative to extended resection, EMR can be combined with ablative methods such as photodynamic therapy (PDT), argon plasma coagulation (APC) or high power radiofrequency (the BARRX system).

Patients with residual areas of non-neoplastic Barrett's epithelium after EMR of a focal lesion have to undergo long-term surveillance for early detection of metachronous neoplasia. Alternatively complete eradication of Barrett's can be considered, but this approach will also require follow-up endoscopy because of limited data on the long-term outcome. Therefore patients with early neoplasia in a long-segment Barrett's esophagus must be informed about the frequent need for repeat interventions, the risk of stricture formation and that information about long-term results is still limited. The risks and benefits of the endoscopic approach must be balanced against the results of subtotal esophagectomy. Limited esophageal resection may be an alternative but lymph node resection can be incomplete. This is of concern in patients with an increased risk of lymph node metastasis due to deeper tumor infiltration not diagnosed, for example, by EMR prior to surgery.

Contraindications

EMR of early esophageal neoplastic lesions should not be performed in the presence of:

- Obvious tumor infiltration into the submucosa or even deeper layers of the esophageal wall according to endoscopic appearance (lack of type 0 criteria) and/or EUS findings or
- enlarged local lymph nodes not related to local inflammation (e.g. not locally inflamed due to reflux esophagitis); EUS guided FNA can be considered in undetermined cases.

Relative contraindications are widespread or multifocal lesions which require circumferential or extended longitudinal resections. Limited data for widespread EMR indicate a high risk of stricture formation. Strictures may require repeated dilation and may have a negative impact on surveillance due to difficulties of detection and treatment of residual or recurrent lesions.

Technique of EMR

Several endoscopic techniques have been advocated for mucosal resection. In patients with early esophageal neoplasias, these should allow a safe and targeted resection of focal lesions as well as widespread removal of multifocal areas or even complete eradication of Barrett's epithelium. These aims can be best achieved with the endoscopic mucosal resection cap (EMR-C) procedure or the ligate-and-cut technique. Recent comparative trials have shown similar results for the two methods. Before EMR, electrocautery dots should be marked using the tip of a snare or a needle-knife around the

circumference of focal lesions, with a safety margin of at least 2 mm. High resolution endoscopes and narrow-band imaging (NBI) or chromoendoscopy are helpful for a precise delineation of the tumor margins. Marking may be not required in the case of easily visible neoplastic nodules or planned widespread EMR.

EMR-C is performed with a cap (Olympus, Tokyo, Japan) mounted on the tip of a forward-viewing endoscope. We usually prefer a hard cap with an oblique distal end. A large-bore soft cap provides a larger specimen but targeting of lesions can be more difficult, particularly if the esophageal lumen is narrow. To decrease the potential risk of perforation, saline solution is injected into the submucosal layer to separate the mucosa from the muscle layer. We add a small amount of indigo carmine 0.1% to give the solution a slightly blue color. The dye helps to color the submucosa which facilitates delineation of the lateral resection margins and discrimination from the red layer of the muscularis propria. The amount of solution injected depends on the diameter of the targeted area, the size of the cap and the degree of lifting. Intensive injection may reduce the risk of perforation, particularly when a large cap is used, but will reduce the size of the specimen. A specially designed thin snare is then “pre-looped” in the cap; for this purpose normal mucosa of the esophagus or the stomach is partially sucked into the outlet of the cap. The previously inserted snare is then opened and positioned into the ridge at the internal distal end of the cap. The targeted lesion can then be sucked into the cap until the cap has been completely filled with tissue, which is indicated by a “red-out” of the image. After firm strangulation by the snare wire, the suction is released to let the pseudopolyp thus created out of the cap. For subsequent resection we prefer the endocut mode (Vaio; Erbe, Tübingen, Germany) with level 3, cutting interval 6, and cutting duration 1. The specimen can then be easily retrieved by aspiration into the cap and withdrawal of the endoscope. The procedure can be repeated for piecemeal resection by positioning the cap laterally to the previous resection area of which only the outer margin should be sucked into the cap, to decrease the risk of perforation.

With the ligate-and-cut technique, an artificial polyp is created at the site of the lesion using an esophageal varices ligator. There seems to be no need for submucosal injection according to previous reports on this technique. A transparent cap loaded with a rubber band is used for suction of the targeted lesion into the cap with subsequent release of the band. A polypectomy snare is then positioned above or below the band for resection of the created pseudopolyp. We prefer to cut below the band to obtain a larger specimen. The Multiband Mucosectomy (MBM) kit (Duetto system; Cook Medical, Bloomington, Indiana, USA) is useful for piecemeal resection. The snare of the kit can be kept in the accessory channel of the endoscope and it can be easily positioned over the ligated tissue. A single system facilitates the performance of up to six resections without the need to remove the endoscope. This technique is obviously faster and easier to perform than the cap procedure in particular for widespread EMR. However the visibility through the MBM cap is inferior to that for the fully transparent cap for EMR-C, which makes it more difficult to target focal lesions and avoid tissue bridges

between multiple resection areas. In addition the size of the resected specimen is smaller for EMR done using the MBM system compared with EMR-C done using a large cap.

We repeat EMR in the same session until all coagulation markings for a focal lesion have disappeared or until all of the area targeted for widespread resection has been removed.

Management of complications

Bleeding from small submucosal vessels may occur during EMR. We use the cap on the tip of the endoscope for compression and localization of the bleeding site. This approach usually makes it easy to grasp the vessel with a coagulation forceps (hot biopsy forceps or specially designed forceps for hemostasis) and to use diathermy (the soft mode of the Vaio system) for definitive hemostasis. During coagulation, we pull the entrapped tissue with the vessel towards the cap to decrease the risk of deeper diathermic damage to tissue. This technique nearly always achieves hemostasis. In the case of failure hemoclips can be used, but their application makes it more difficult to continue with piecemeal EMR. We never had a case of esophageal perforation which had been reported as rare and severe adverse event of EMR. If any small defect had occurred, we would have tried to close it with clips with confirmation by esophagography and a computed tomography (CT) scan to exclude a larger extraluminal fluid collection. Conservative management with antibiotic prophylaxis and total parenteral nutrition seems to be justified if there is no evidence of mediastinitis. However close collaboration with a surgical consultant is mandatory.

The risk of stricture formation depends on the extent of EMR and seems to be particularly high in the case of circumferential resection in a single session. Stepwise widespread EMR done in several sessions may reduce the incidence but EMR becomes more difficult if the esophageal lumen has become narrower due to scar formation. We manage symptomatic strictures caused by EMR by using bougienage in the same way as for peptic stenoses. Unfortunately this frequently has to be repeated due to recurrence, in some patients for example, up to five times at weekly intervals.

Follow-up

After EMR the patients have an overnight hospital stay. We allow them to drink but not to eat, so that esophagogastroduodenoscopy (EGD) can be performed if there is any evidence of delayed bleeding. Asymptomatic patients are discharged the morning after EMR with no further restrictions and with continuation of medication with proton pump inhibitors (PPIs) at a standard dosage twice daily.

According to our follow-up protocol, EGD is repeated every 3 months in the first year after EMR and then every 6 months. We consider resection of neoplasia in Barrett's to be complete if there is no macroscopic evidence of residual neoplastic tissue and histology confirms tumor-free margins of resected areas and neoplasia-free EMR scars. Residual Barrett's epithelium is monitored by endoscopy,



with biopsies from suspicious lesions and routine biopsies according to the Seattle protocol.

We are currently participating in a multicenter trial to study the efficacy and safety of high power radiofrequency ablation (BARRX) of residual Barrett's epithelium after EMR of early neoplasia.

Residual, recurrent, or metachronous neoplastic lesions can be usually resected by EMR without changing the techniques. However the removal of specimens can become more difficult due to scar formation and insufficient lifting of the mucosa. Ablation by APC, PDT or BARRX can be done but we recommend that multiple biopsies of the targeted area should first be done, to exclude more advanced neoplastic tumor stages.

Conclusions

EMR is a promising technique for local treatment of HGD or mucosal cancer in patients with Barrett's esophagus or SCC. Several series demonstrate that different techniques of EMR are feasible and safe for this indication. The EMR-cap technique and the ligate-and-cut procedure seem to be equivalent. The selection depends on the size of the targeted area and the local expertise.

In contrast to ablative methods such as PDT, EMR allows histopathological evaluation and frequently reveals more advanced tumor stages. Limitations relate to malignant lesions or HGD which can not be endoscopically identified or to multifocal lesions. EMR is technically possible for large areas of Barrett epithelium with complete eradication but must be evaluated in appropriate trials. Alternatively EMR can be combined with ablation by PDT, APC or BARRX, but long-term data regarding this approach are limited.

EMR promises to be curative after complete local remission. The risk of recurrent, synchronous, or metachronous lesions has to be compared with the morbidity and mortality of esophagectomy or alternative nonsurgical methods. EMR with curative intention should be carried out only in appropriate prospective trials which include close follow-up examinations.

“HOW I DO IT”

Endoscopic mucosal resection (EMR) in the esophagus

Comment

Hiroyasu Makuuchi MD

Professor and Chairman

Department of Digestive Surgery

Tokai University School of Medicine, Isehara, Japan

Introduction

As a result of the advances in endoscopic instrumentation and the greater use of iodine staining, the detection of early stage esophageal carcinoma has been rapidly increasing. Endoscopic mucosal resection (EMR) techniques have gained popularity while endoscopic submucosal dissection (ESD) methods have also been introduced in some institutions. The acquisition of skills in early detection of esophageal carcinoma and in EMR techniques is now essential for endoscopists.

While EMR is regarded as the treatment of choice for early esophageal carcinoma, informed consent must be obtained, with the patient having been made aware of the possibilities of perforation, bleeding, stenosis, and other complications, as well as, in rare cases, lymph node recurrence, distant organ recurrence, local recurrence and metachronous metastases.

EMR yields an excellent prognosis, with a 97.1% 5-year survival rate in our experience.

Indications

Cases in which EMR and ESD are indicated are those with endoscopically resectable lesions not associated with lymph node metastases or organ metastases. The best indications are high grade intraepithelial neoplasia (HGIN), lesions of carcinoma in situ (Tis), and those with a depth of invasion as far as the proper mucosal layer (T1a, m2), because lymph node metastases are unlikely in such lesions.

Since lymph node metastases are present in approximately 10% of cases with lesions reaching the muscularis mucosae (T1a, m3) and approximately 15% of cases with invasion up to the upper one third of the submucosa (T1b, sm1), these are considered to be relative indications for the procedures. Histopathological examinations in EMR/ESD cases showed that when the depth of invasion is m3 or sm1, with lymph vessel invasion (ly(+)) or a significant infiltration (INF-γ), the probability of lymph node



metastasis is even higher in 39% of cases. It is necessary to examine the depth of invasion and to assess the possibility of lymph node metastasis by diagnostic imaging using endoscopic ultrasound (EUS) or computed tomography (CT) before performing EMR or ESD. However, the diagnostic accuracy remains at only around 80%, suggesting the difficulty of assessment.

- The indications are the same for adenocarcinoma in Barrett's esophagus. The muscular layer below the columnar epithelium is an acquired muscular layer formed by glandular tissue and can be regarded as a basement membrane of squamous epithelium. It is best to determine indications based on the muscularis mucosae of the esophagus as standard.
- The size of the lesion should be under 3 cm in longitudinal extent. Lesions of more than 5 cm in length would present greater technical difficulties and there will be some parts with deeper invasion and increased risk of lymph vessel invasion and lymph node metastasis. Of course the procedures are indicated if the entire lesion is Tis or HGIN.
- Lesions should be no more than two-thirds of the circumference of the esophagus. Lesions with a greater extent around the circumference have a higher risk of postoperative stenosis. Resection around the entire circumference should be avoided.
- Many esophageal carcinomas have multiple lesions. It is possible to resect about three lesions in one day. When there are more, it is recommended that resection is carried out on separate days, in which case it is better to start from the lesions on the anal side. Resection from the oral side can cause stenosis, making it difficult to approach the remaining lesions.

Contraindications

EMR and ESD are contraindicated in cases of:

- Massive tumor invasion in the submucosal layer: lymph node metastases are present in 40%–50% of these cases.
- Lymphadenopathy that is obviously metastasis according to EUS or CT findings. EMR and ESD are then contraindicated even when the depth of invasion is T1a, m3 or T1b, or sm1. In particular, carcinomas detected by EUS-fine-needle aspiration (FNA) represent contraindications.
- Patients with a tendency to bleeding (e.g. patients with cirrhosis or esophageal varices). Leukemia or hemophilia are contraindications. The procedures are contraindicated in patients on anticoagulant therapy but may be performed after halting the treatment.
- Lesions inside or partially inside an esophageal diverticulum: these cases are susceptible to perforation.

- Adhesion between the mucosa containing the lesion and the lamina propria mucosae, i.e. where there is no elevation of the mucosa when saline solution is injected. Careful manipulation by an experienced endoscopist is required as esophageal perforations occur easily in these cases.
- Esophageal varices; but EMR or ESD may be possible after these have been treated with endoscopic injection sclerotherapy (EIS) or endoscopic variceal ligation (EVL). Esophageal varices generally represent contraindications, because the patients are prone to bleeding and have a higher risk of adhesion of mucosa and muscularis propria. Ablation may be performed carefully by an experienced surgeon.
- Massive invasions into the submucosal layer (T1b, sm2/sm3). However EMR or ESD may be carried out in these patients if curative surgery or chemoradiotherapy is impossible due to their poor general condition, provided that no lymphadenopathy is found by EUS or CT.

Techniques of EMR and ESD

The most common EMR methods are the endoscopic mucosal resection cap (EMR-C), endoscopic esophageal mucosal resection (EEMR) tube, and strip biopsy methods. ESD is a new means of ablating the submucosal layer by dissection of the mucosa around the lesion. The strip biopsy method often results in piecemeal resection. The ESD method requires a high level of skill.

With the EEMR method, the use of a soft cap rather than a hard cap reduces the risk of perforation. With a larger lesion, a large-bore soft cap with an oblique distal end is useful but may be more difficult to pass through the orifice of the esophagus. We prefer the EEMR tube method (the “four-step” method). However the scarce availability of the EEMR tube (Create Medic Co., Yokohama, Japan) outside of Japan is a problem. Briefly, the approach is as follows:

- 1 Identify the area of the lesion using iodine staining.
- 2 Inject saline solution with 0.02% indigo carmine into the submucosal layer just below the lesion until the entire lesion is elevated.
- 3 Insert the EEMR tube, mounted on an endoscope, and position it immediately in front of the lesion. Pass the snare through the side channel of the EEMR tube and open it above the targeted lesion.
- 4 Use the endoscope to apply aspiration inside the EEMR tube to bring the mucosa into the tube.
- 5 Tighten the snare and resect the mucosa using the endocut mode. Remove it together with the endoscope, using aspiration.
- 6 The procedure can be repeated for any residual lesion.



- 7 If the residual lesion is small, electrocautery can be applied. Insert the grasping forceps through the working channel of the endoscope and pass the snare through the side channel of the EEMR tube. Grasp the mucosa with the remaining lesion with the forceps. Close the snare and apply electrocautery.
- 8 Hot biopsy may be used to trim the resected margin or to remove the a residual lesion within the resected area. Argon plasma coagulation (APC) is another alternative.

Management of complications

Esophageal perforation

The most serious complication of EMR and ESD is esophageal perforation. With experienced staff the incidence rate is under 1%.

Prevention. The following points should be taken into consideration:

- EMR should not be carried out when there is no mucosal swelling upon injection of the saline solution.
- Snaring of the ulcer base which has already been subjected to EMR should be avoided.
- EMR should not be done on diverticular lesions.

Management. If esophageal perforation occurs:

- There is no need for urgent surgical intervention if there is no intrathoracic rupture. It is advisable not to try to close the perforation with clips.
 - (a) Administer Parenteral nutrition - the patient must not eat or drink.
 - (b) Administer antibiotics.
 - (c) Use intermittent aspiration with an indwelling nasogastric tube in the esophagus. ~~The~~
- The perforation should close spontaneously after 10 to 14 days.
- Continue careful surveillance, while considering possible surgical intervention including drainage if necessary.
- Pneumothorax occurs when the mediastinal pleura is perforated causing intrathoracic rupture. Surgical intervention is necessary in most of these cases. Perform chest drainage if it is possible to close the perforation using endoscopically placed clips. The clinician should bear in mind that a prolonged endoscopic treatment can cause tension pneumothorax.

Esophageal stenosis

The risk of esophageal stenosis is particularly high when mucosal resection extends around more than

three-quarters of the circumference of the esophagus. It will inevitably occur when resection extends to more than four-fifths of the circumference.

Prevention. Mucosal resection should be limited to two-thirds of the circumference to prevent esophageal stenosis.

Management. When esophageal stenosis occurs:

- Dilation should be repeated every week using a through-the-scope (TTS) balloon dilator, a mercury-filled bougie or a tungsten-filled bougie. It should be repeated for up to 3 months in some patients.
- Dilations must be accompanied by conservative management and care should be taken to prevent esophageal perforation.
- We do not recommend the use of expandable metallic stents (EMSs) as there are risks of perforation upon removal, and of recurrence of stenosis after removal. If an EMS is inserted, it should be removed within 1 month.

Bleeding

Arterial bleeding frequently occurs and is not preventable. For hemostasis when bleeding from arterioles is seen during EMR:

- 1 Grasp the bleeding site using hot biopsy forceps or hemostatic forceps and stop the bleeding using the soft coagulation mode.
- 2 If that is difficult, use the tip of the endoscope for compression or inject saline with epinephrine to reduce the amount of bleeding, and electrocoagulate.

Postoperative bleeding is extremely rare.

Aneurysmal hemorrhage should be treated with EIS, EVL or clipping.

Postoperative care

After EMR/ESD, we allow patients to drink water but not to eat that day. A mucoprotective agent (sodium alginate, aluminum hydroxide) is administered but antibiotics are not usually used. Patients are started on a liquid diet the following day, followed by 50% liquid rice gruel (1:10–12 rice to water) and regular rice gruel (1:5–7 rice to water). Patients are discharged after 3 or 4 days.

Follow-up

- Endoscopic examination is repeated every 6 months. Perform EMR or APC if an area stains positively with iodine dye.
- Endoscopic examination should be carried out with careful attention to the possibility of



accompanying head and neck carcinoma.

- In the case of T1a, m3 or T1b, or sm1 lesions, CT or EUS should be repeated every 4 months, taking care to look for any sign of lymph node recurrence.
- Special attention should be paid to the possibility of metachronous multiple esophageal carcinomas, as these develop in 7%–8% of patients.

Conclusions

- EMR and ESD have revolutionized the treatment of early-stage esophageal carcinoma. We believe we should try to expand the indications as much as is reasonably possible, for there is a huge difference between surgical intervention and endoscopic treatment.
- EMR and ESD should be performed by skilled endoscopists with sufficient training.
- Patients must be given adequate information prior to the treatment, so that properly informed consent can be given.
- Periodic endoscopic examination using iodine staining is essential for the early detection of lesions for which EMR or ESD is indicated.

“HOW I DO IT”

Endoscopic mucosal resection (EMR) in the esophagus

Summary

Kenneth K. Wang, MD

Director of Advanced Endoscopy, Professor of Medicine

Division of Gastroenterology and Hepatology

Mayo Clinic, Rochester, Minnesota, USA

Rationale and indications

Endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) are both directed towards complete removal of early esophageal carcinoma. They both offer the endoscopist the opportunity to examine the histology of the lesion being treated, unlike any other available ablative procedure. This distinction is critical since the depth of invasion of the esophageal cancer clearly defines the metastatic potential of the lesion, as well outlined by Dr. Makuuchi who has been a pioneer in this area. The exact depth at which metastatic risk becomes substantial has been debated. It has been disputed whether depths of invasion of m3 (lower third of the mucosa) and sm1 (top third of the submucosa) are associated with substantial risk of metastasis. A recent large Japanese study involving 464 patients with squamous cell cancers found that sm1 cancers have a metastasis potential of 53.1% while m3 cancers also have a risk of approximately 18%. It is generally felt that if there is no evidence of lymphatic invasion, m3 lesions can be safely treated with mucosal resection. EMR can also be used as a diagnostic tool, since often (40% of cases), a nodule in Barrett's esophagus can be misinterpreted as noncancerous rather than cancerous because of the limited depth of endoscopic biopsies. Thus the indications for EMR are diagnostic and therapeutic for esophageal cancer while ESD, because of its ability to completely resect the entire lesion, is primarily useful for its therapeutic benefits.

Lesions that are approachable with either technique should be confined to less than two-thirds of the esophageal circumference to avoid the formation of strictures after mucosal resection. It is important to note that strictures can form even after a single mucosa resection since the degree of scar formation is very individual. Although generally the lesion size should be less than 3 cm, it is permissible to resect larger areas so long as the lesion is felt to be superficial.

Tumor staging is important in the treatment of early esophageal neoplasia, with endoscopic ultrasound and computed tomography (CT) scans. EMR and especially ESD should not be performed in the setting



of known metastatic esophageal cancer.

It is important to obtain a reasonable “lift” from submucosal injection. It is also more difficult to resect areas of neoplastic tissue that have been previously resected because of the scarring that has occurred. This situation occurs when the mucosal resection or even submucosal dissection specimen demonstrates neoplasia extending to the lateral margins of the resection.

Techniques of EMR and ESD

The techniques of EMR and ESD have been performed quite differently depending on individual preferences. As indicated by Drs. Makuuchi and Neuhaus, the most commonly used approach in Europe and the United States uses the cap device (Olympus, Tokyo, Japan). The type of cap employed varies quite a lot in terms of shape (oblique or flat tip), construction (soft or hard plastic), and diameter.

I find that for beginners, the ligating cap (Wilson Cook, Indianapolis, USA) is the easiest to use. This cap functions similarly to a six-band variceal ligation device and allows the endoscopist to band the lesion to form the pseudopolyp, prior to snare resection with a multiuse hexagonal snare which can be passed through the therapeutic channel of the ligating device. The ligating cap does have disadvantages, including decreased visibility, and does remove a slightly smaller piece of tissue. This device is simple to use, but is less desirable in situations where the mucosa is firm, such as after prior mucosal resection or uncontrolled reflux disease. Then a hard cap device seems to work better.

My personal preference is for the flat hard caps since the oblique caps will cut the mucosa when suctioning has been started. I prefer to suction the mucosa into the cap two or three times to be certain that the lesion is centered correctly in the specimen area and that the margins I wish to obtain can be resected. With the oblique cap, as soon as the mucosa has been lacerated, the tissue continues to enter the cap the same way and adjustments cannot be made. The soft caps gather more tissue but it is more difficult to regulate the amount of tissue coming into the cap.

ESD should only be performed by experts. It requires a good lift with a solution that can maintain the space between the mucosa and submucosa. We use hydroxypropyl methylcellulose, which is obtained as an ophthalmic solution and is sterile. We color this with indigo carmine to make the area of submucosa more apparent. This compound can maintain a cushion for at least 30 minutes. The dissection is performed with a variety of devices, amongst which our favorite is the triangle tip-knife that allows use of the points of the triangle for cutting and the flat end for cautery. It is important to initially circumscribe the lesion by cutting through the mucosa completely around the lesion, with a margin of about 2–3 mm from areas of known neoplasia. The lesion should then be lifted from the distal end using a cap (an EMR cap can be used), and dissection is done laterally in a side to side motion, taking care to stay within the submucosal space. The greatest challenge is to visualize the plane of dissection while carefully resecting the specimen in a proximal direction.



Complications

Complications are not common with EMR and can generally be managed conservatively. Bleeding from small vessels is the most common adverse event. Cautery with a hot biopsy forceps works well for small vessels. The forceps should not be used to remove any tissue, simply to close and then apply cautery, then the tissue should be released. Sealing the resection site with multiple hemoclips is also often our practice after bleeding. Perforations are rare in EMR of the esophagus and I have not encountered one.

ESD is much more commonly associated with perforations, which are generally small and can be sealed with hemoclips in the majority of cases. If it is a large perforation that cannot be sealed, surgical management will be needed. Strictures usually occur within 2 weeks of the procedure and need to be managed with aggressive dilation.

Postoperative care

Our EMR patients are managed as outpatients. They are monitored in the endoscopy laboratory for an hour after the procedure. They are instructed to return if they bleed or have increased pain. A clear liquid diet for 24 hours is recommended, with the instruction to advance to a normal diet as tolerated. Often, bleeding complications appear 1–2 weeks after the procedure. ESD patients should be observed in hospital for 24 hours after the procedure to confirm that there is no perforation.

