

Endoscopic Radiofrequency Ablation or Cryoablation for Barrett Esophagus



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DESCRIPTION

Barrett's esophagus is a condition in which the normal squamous epithelium is replaced by specialized columnar-type epithelium known as intestinal metaplasia, in response to irritation and injury caused by gastroesophageal reflux disease (GERD). Intestinal metaplasia is a precursor to adenocarcinoma. Individuals may need to undergo surveillance obtain a biopsy. Individual then may be treated with mucosal ablation techniques such as radiofrequency ablation (RFA) or cryoablation.

The current management of Barrett's esophagus may include the treatment of GERD and surveillance endoscopy to detect progression dysplasia or adenocarcinoma. Dysplasia is often divided into two grades based on the appearance of the cells.

- According to the American Cancer Society low- and high-grade dysplasia are defined as follows:
 - **Low-Grade Dysplasia**
Some of the cells look abnormal when seen under the microscope. These cells may look a lot like cancer cells in some ways, but unlike cancer, they do not have the ability to spread all over your body. This is a very early form of pre-cancer of the esophagus.
 - **High-Grade Dysplasia**
Some of the cells contained in the area of Barrett's esophagus look very abnormal under the microscope. This is a more advanced pre-cancer of the esophagus than low-grade dysplasia.

Barrett Esophagus and Risk of Esophageal Carcinoma

The esophagus is normally lined by squamous epithelium. BE is a condition in which the normal squamous epithelium is replaced by specialized columnar-type epithelium, known as intestinal metaplasia, in response to irritation and injury caused by gastroesophageal reflux disease. Occurring in the distal esophagus, BE may be of any length; it may be focal or circumferential and can be seen on endoscopy as being a different color than the background squamous mucosa. Confirmation of BE requires a biopsy of the columnar epithelium and microscopic identification of intestinal metaplasia.

Intestinal metaplasia is a precursor to esophageal adenocarcinoma, which is thought to result from a stepwise accumulation of genetic abnormalities in the specialized epithelium, resulting in the phenotypic expression of histologic features from LGD, to high-grade dysplasia (HGD), to carcinoma. Two large epidemiologic studies published in 2011 reported the risk of progression to cancer in patients with BE. One reported the rate of progression to cancer in more than 8000 patients with a mean duration of follow-up of 7 years (range, 1-20 years). The de novo progression to cancer from BE at 1 year was 0.13%. The risk of progression was reported as 1.4% per year in patients with LGD and 0.17% per year in patients without dysplasia. This incidence translates into a risk of 10 to 11 times that of the general population. The other study identified more than 11000 patients with BE and, after a median follow-up of 5.2 years, it reported that the annual risk of esophageal adenocarcinoma was 0.12%. Detection of LGD on index endoscopy was associated with an incidence rate for adenocarcinoma of 5.1 cases per 1000 person-years, and the incidence rate among patients without dysplasia was 1.0 case per 1000 person-years. Risk estimates for patients with HGD were slightly higher. The reported risk of progression to cancer in BE in older studies was much higher, with an annual incidence of risk of 0.4% to 0.5% per year, with risk estimated at 30 to 40 times that of the general population. Current surveillance recommendations have been based on these higher risk estimates.

There are challenges in diagnostically differentiating between nondysplastic BE and BE with LGD; they are important when considering treatment for LGD. Both sampling bias and interobserver variability have been shown to be problematic. Therefore, analysis of progression to carcinoma in BE with intestinal metaplasia versus LGD is difficult. Initial

diagnosis of BE can also be a challenge with respect to histologic grading because inflammation and LGD can share similar histologic characteristics.

One approach to risk-stratify patients with an initial diagnosis of LGD has been to use multiple pathologists, including experts in gastrointestinal histopathology, to confirm the initial diagnosis of LGD. There is a high degree of interobserver variability among the pathology readings of LGD versus inflammatory changes, and the resultant variability in pathology diagnosis may contribute to the variable rates of progression of LGD reported in the literature. Kerkhof et al. (2007) reported that, in patients with an initial pathologic diagnosis of LGD, review by an expert pathologist would result in the initial diagnosis being downgraded to nondysplasia in up to 50% of cases. Curvers et al. (2010) tested this hypothesis in 147 patients with BE who were given an initial diagnosis of LGD. All pathology slides were read by 2 expert gastrointestinal pathologists with extensive experience in BE; disagreements among experts in the readings were resolved by consensus. Once this process was completed, 85% of initial diagnoses of LGD were downgraded to nondysplasia, leaving 22 (15%) of 147 patients with a confirmed diagnosis of LGD. All patients were followed for a mean of 5.1 years for progression to HGD or cancer. For patients with confirmed LGD, the rate of progression was 13.4%, compared with 0.5% for patients who had been downgraded to nondysplasia.

The strategy of having LGD confirmed by expert pathologists is supported by the results of an RCT by Phoa et al (2014), which required confirmation of LGD by a central expert panel following initial diagnosis by a local pathologist. Of 511 patients with an initial diagnosis of LGD, 264 (52%) were excluded because the central expert panel reassigned the classification of LGD, most often from LGD to indefinite or nondysplasia. These findings were further confirmed in a retrospective cohort study by Duits et al. (2015) who reported on 293 BE cases with LGD diagnosed over an 11-year period and submitted for expert panel review. In this sample, 73% of subjects were down staged.

Management of Barrett Esophagus

The management of Barrett Esophagus (BE) includes the treatment of gastroesophageal reflux disease and surveillance endoscopy to detect progression to high-grade dysplasia (HGD) or adenocarcinoma. The finding of HGD or early-stage adenocarcinoma warrants mucosal ablation or resection (either endoscopic mucosal resection [EMR] or esophagectomy).

EMR, either focal or circumferential, provide a histologic specimen for examination and staging (unlike ablative techniques). One 2007 study provided long-term results for EMR in 100 consecutive patients with early Barrett-associated adenocarcinoma (limited to the mucosa). The 5-year overall survival was 98% and, after a mean of 36.7 months, metachronous lesions were observed in 11% of patients. In a review by Pech and Ell (2009), the authors stated that circumferential EMR of the entire segment of BE leads to a stricture rate of 50%, and recurrences occur at a rate of up to 11%.⁹

Ablative Techniques

Available mucosal ablation techniques include several thermal (multipolar electrocoagulation [MPEC], argon plasma coagulation [APC], heater probe, neodymium-doped yttrium aluminum garnet [Nd:YAG] laser, potassium titanyl phosphate[KTP]-YAG laser, diode laser, argon laser, cryoablation) or nonthermal (5-aminolevulinic acid, photodynamic therapy) techniques. In a randomized phase 3 trial reported by Overholt et al. (2005), photodynamic therapy was shown to significantly decrease the risk of adenocarcinoma in BE.

The CryoSpray Ablation system uses a low-pressure spray for applying liquid nitrogen through an upper endoscope. Cryotherapy allows for the treatment of uneven surfaces; however, a disadvantage of the treatment is the uneven application inherent in spraying the cryogen.

The HALO system uses radiofrequency energy and consists of 2 components: an energy generator and an ablation catheter. The generator provides rapid (i.e., <1 second) delivery of a predetermined amount of radiofrequency energy to the catheter. The HALO90 or the HALO360 is inserted into the esophagus with an endoscope, using standard endoscopic techniques. The HALO90 catheter is plate-based and used for focal ablation of areas of BE up to 3 cm. HALO360 uses a balloon catheter that is sized to fit the individual's esophagus and is inflated to allow for circumferential ablation.

Radiofrequency ablation affects only the most superficial layer of the esophagus (i.e., the mucosa), leaving the underlying tissues unharmed. Measures of efficacy for the procedure are the eradication of intestinal metaplasia and the postablation regrowth of the normal squamous epithelium. (Note: The eradication of intestinal metaplasia does not leave behind microscopic foci). Reports of the efficacy of the HALO system in ablating BE have been as high as 70% (comparable with alternative methods of ablation [e.g., APC, MPEC]), and even higher in some reports. The incidence of leaving behind microscopic foci of intestinal metaplasia has been reported to be between 20% and 44% with APC and 7% with MPEC; studies using the HALO system have reported 0%. Another potential advantage of the HALO system is that it is an automated process that eliminates operator-dependent error, which may be seen with APC or MPEC.

The risk of treating HGD or mucosal cancer solely with ablative techniques is undertreatment for approximately 10% of patients with undetected submucosal cancer, in whom esophagectomy would have been required.

Radiofrequency Ablation for Barrett Esophagus with High-Grade Dysplasia

Clinical Context and Therapy Purpose

In patients diagnosed with BE with HGD, the risk of progression to cancer is relatively high, and esophageal adenocarcinoma is associated with high morbidity and a 5-year survival rate of up to 13%. Therefore, intervention with esophagectomy or RFA may be strongly indicated.

The purpose of endoscopic RFA in patients who have BE with HGD is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does the use of RFA improve the net health outcome in patients with BE with HGD?

The following PICO was used to select literature to inform this review.

Populations

The relevant population of interest is patients with BE with HGD.

Interventions

The therapy being considered is endoscopic RFA.

Comparators

The following therapies and practices are currently being used to treat BE: esophagectomy, endoscopic mucosal resection (EMR), and surveillance.

Outcome

The general outcomes of interest are symptoms (e.g., pain) and functional outcomes (including swallowing).

Beneficial outcomes include reductions in progression to carcinoma and longer-term maintenance of eradication of dysplasia.

Harmful outcomes include damage to the esophagus resulting in difficulty swallowing. Morbidity from treatment would be assessed within 30 days after the procedure.

Study Selection Criteria

Methodologically credible studies were selected using the following principles:

- To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
- In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
- To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.

Review of Evidence

Systematic Reviews

Chadwick et al. (2014) reported on a systematic review that compared RFA with complete EMR for the treatment of BE. Twenty studies (22 articles) were reviewed, including 2 RCTs, 10 cohort studies on EMR, and 8 cohort studies on RFA. The only study that compared RFA with EMR was an RCT by van Vilsteren et al. (2011); the other

RCT was by Shaheen et al (2009, 2011; see below). The studies were heterogeneous in design. A total of 1,087 (532 EMR, 555 RFA) patients with HGD or intramucosal carcinoma were included in the studies reviewed. The median number of resections or RFA sessions required for the eradication of BE was 2. Complete EMR and RFA eradicated BE dysplasia in 95% and 92% of patients, respectively. Eradication was maintained in 95% of EMR patients at a median follow-up of 23 months and in 94% of RFA patients at a median follow-up of 21 months. Fewer RFA patients experienced short-term adverse events (2.5%) than those who received complete EMR (12%). Esophageal strictures requiring additional treatment occurred in 4% of RFA patients and 38% of complete endoscopic resection patients.

Randomized Controlled Trials

RFA may be used alongside focal endoscopic resection. In the intention-to-treat analysis of a prospective interventional study by Phoa et al. (2016) that included 132 subjects with BE and HGD or early cancer treated with endoscopic resection followed by RFA, complete eradication of neoplasia and complete eradication of intestinal metaplasia occurred in 92% and 87% of subjects, respectively. At a median follow-up of 27 months, neoplasia and intestinal metaplasia had recurred in 4% and 8% of subjects, respectively.

Van Vilsteren et al. (2011) reported on the results of a multicenter randomized trial that compared the safety of stepwise radical endoscopic resection (SRER) with focal EMR followed by RFA for complete eradication of BE 5 cm or less with HGD or early cancer. Patients in the SRER group underwent a piecemeal EMR of 50% of BE followed by serial EMR. Patients in the EMR plus RFA group underwent focal EMR for visible lesions followed by serial RFA. Follow-up endoscopy with biopsies (4-quadrant/2 cm BE) was performed at 6 and 12 months and then annually. The main outcome measures were stenosis rate; complications; complete histologic response for neoplasia; and complete histologic response for intestinal metaplasia (CR-IM). Complete histologic response for neoplasia was achieved in 25 (100%) of 25 SRER patients and in 21 (96%) of 22 patients receiving EMR plus RFA. CR-IM was achieved in 23 (92%) SRER patients and 21 (96%) patients receiving EMR plus RFA. The stenosis rate was significantly higher with SRER (88%) than with EMR plus RFA (14%; $p < .001$), resulting in more therapeutic sessions in SRER (6 vs 3; $p < .001$) due to dilations. After a median follow-up of 24 months, 1 SRER patient had a recurrence of early cancer, requiring endoscopic resection. This trial confirmed that both techniques achieved comparably high rates of CR-IM and complete histologic response for neoplasia but found that SRER was associated with more complications and therapeutic sessions.

The randomized multicenter, sham-controlled trial by Shaheen et al (2009) compared RFA with surveillance alone in patients with BE and dysplasia. RFA was successful in eradicating HGD, with complete eradication at 12 months achieved in 81% of the ablation group versus 19% in the control group ($p < .001$). This trial also confirmed a high-risk of progression to cancer in patients with HGD and established that this progression was significantly reduced in patients treated with RFA. Among 63 patients with HGD in the trial, 19% in the control group progressed to cancer versus 2.4% in the RFA group

($p=.04$). This represented a nearly 90% relative risk reduction for progression to cancer (relative risk, 0.1; 95% confidence interval [CI], 0.01 to 1.0, $p=.04$), and a number needed to treat of 6.0 to prevent 1 case of cancer over a 1-year period.

Longer-term follow-up at 2 to 3 years reported that complete eradication of dysplasia was maintained in most participants with initial HGD. For 54 patients with HGD available for follow-up, all dysplasia was eradicated in 50 (93%) of 54, and all intestinal metaplasia was eradicated in 48 (89%) of 54. After 3 years, dysplasia was eradicated in 55 (98%) of 56 of subjects, and all intestinal metaplasia was eradicated in 51 (91%) of 56. More than 75% of patients with HGD remained free of intestinal metaplasia with a follow-up of longer than 3 years, with no additional therapy.

Section Summary: Radiofrequency Ablation for Barrett Esophagus with High-Grade Dysplasia

For patients who have BE with HGD, there is a relatively high risk of progression to cancer, and interventions to prevent progression are warranted. RFA results in high rates of complete eradication of dysplasia that is durable for at least 2 years. One RCT demonstrated that, following RFA, the progression from HGD to cancer is reduced by approximately 90%, with rates of esophageal strictures of 6%.

Radiofrequency Ablation for Barrett Esophagus with Low-Grade Dysplasia Clinical Context and Therapy Purpose

The purpose of endoscopic RFA in patients who have BE with LGD is to provide a treatment option that is an alternative to or an improvement on existing therapies. The question addressed in this evidence review is: Does the use of RFA improve the net health outcome in patients with BE with LGD?

The following PICO was used to select literature to inform this review.

Populations

The relevant population of interest is patients with BE with LGD.

Interventions

The therapy being considered is endoscopic RFA.

Comparators

The following practice is currently being used to treat BE with LGD: surveillance by gastroenterologists.

Outcome

The general outcomes of interest are symptoms (eg, pain) and functional outcomes (including swallowing)

Beneficial outcomes include reductions in progression to HGD or carcinoma and longer-term maintenance of eradication of dysplasia.

Harmful outcomes include damage to the esophagus resulting in difficulty swallowing.

Morbidity would be assessed within 30 days after the procedure. Conversion to HGD would be measured at 2 to 5 years.

Study Selection Criteria

Methodologically credible studies were selected using the following principles:

- To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
- In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
- To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.

Systematic Reviews

Klair et al. (2021) performed a systematic review and meta-analysis of comparative studies of RFA versus endoscopic surveillance in patients with BE with LGD. The primary outcome was risk of progression to HGD or esophageal adenocarcinoma. The meta-analysis included 4 studies (N=543), including 2 retrospective studies and 2 RCTs. Compared with endoscopic surveillance, RFA was associated with lower odds of progression to either HGD or esophageal adenocarcinoma (odds ratio [OR], 0.17; 95% CI, 0.04 to 0.65). Individually, the progression to HGD maintained significance compared with endoscopic surveillance (OR, 0.23; 95% CI, 0.08 to 0.61), while progression to adenocarcinoma was numerically lower (OR, 0.44; 95% CI, 0.17 to 1.16). However, the findings indicated moderate heterogeneity ($I^2=0.63$) and evidence of publication bias.

In their meta-analysis, Pandey et al. (2018) evaluated RCTs and observational studies to determine the efficacy of RFA in treating BE with LGD compared with surveillance. The 8 studies in the meta-analysis included 619 patients followed up for a median of 26 months. The overall pooled rate of complete eradication of intestinal metaplasia after RFA was 88.17% (95% CI, 88.13% to 88.20%; $p<.001$); the rate of complete eradication of dysplasia was 96.69% (95% CI, 96.67% to 96.71%; $p<.001$). Compared with surveillance, the rates of progression to HGD or cancer were significantly lower with RFA (OR, 0.07; 95% CI, 0.02 to 0.22). The pooled recurrence rate of intestinal metaplasia was 5.6% (95% CI, 5.57% to 5.63%; $p<.001$) and 9.66% (95% CI, 9.61% to 9.71%; $p<.001$) for dysplasia. Although the analysis was limited by its inclusion of observational cohort studies and the sample sizes of patients receiving RFA were all less than 100 patients, all studies supported the use of RFA for LGD BE. The authors concluded that RFA is safe and effective for eradicating intestinal metaplasia and dysplasia and reducing progression from LDG to HGD or cancer in the short term. Longer-term outcomes, however, warrant further research.

Almond et al. (2014) reported on the results of a meta-analysis of studies using endoscopic therapy to treat BE with LGD. The analysis included 37 studies, 9 of which evaluated RFA alone, including the RCT by Shaheen et al. (2009). Most studies were small, with the Shaheen et al. (2009) RCT representing the largest study (52 with LGD treated with RFA). For patients treated with RFA, the pooled incidence of cancer or progression to HGD was 10.77 per 1000 patient-years (95% CI, 2.22 to 31.48 per 1000 patient-years). For RFA-treated patients, pooled rates of complete eradication of intestinal metaplasia and complete eradication of dysplasia were 87.2% (95% CI, 76.2% to 93.5%) and 90.6% (95% CI, 81.0% to 95.6%), respectively.

Randomized Controlled Trials

Several RCTs comparing RFA with surveillance in patients with BE with LGD have been published that were not included in the systematic reviews by Klair et al. (2021), Pandey et al (2018), and Almond et al (2014), and the TEC Assessment (2010). Barret et al. (2020) performed an RCT that randomized 82 patients with confirmed LGD at 14 centers in France to RFA or surveillance. Of 40 patients randomized to RFA, 37 actually received treatment. The primary outcome (prevalence of LGD 3 years after randomization) was significantly improved with RFA in the per-protocol analysis (40.5% vs. 67.5%; OR, 0.33; 95% CI, 0.13 to 0.83), but not in the intention-to-treat analysis (34.3% vs. 58.1%; OR, 0.38; 95% CI, 0.14 to 1.02). The secondary outcome of neoplastic progression rate to HGD or early adenocarcinoma with RFA versus surveillance was 12.5% versus 26.2% ($p=.15$), respectively, in the ITT analysis.

Phoa et al. (2014) also conducted an RCT comparing RFA with surveillance in patients with LGD; this RCT was included in the meta-analysis by Klair et al. This trial randomized 140 patients with BE and confirmed LGD; 4 patients were excluded after randomization for not meeting study inclusion criteria at further review, leaving 136 patients in the modified intention-to-treat analysis. “Confirmed” LGD was defined as a diagnosis of LGD by the local pathologist with confirmation by a centralized expert panel of pathologists convened for the trial. The primary outcome measure was the occurrence of either HGD or adenocarcinoma up to 3 years after randomization. Secondary outcomes were the complete eradication of dysplasia, the absence of intestinal metaplasia, and adverse events.

The trial was terminated early after an interim analysis determined the superiority of RFA. At termination, all patients had reached the 24-month follow-up time point, and the median follow-up was 36 months. The occurrence of adenocarcinoma was significantly lower in the RFA group (1.5%) than in the surveillance group (8.8%; $p<.03$), and the occurrence of HGD was also significantly lower for the RFA group (1.5%) than for the surveillance group (26.5%; $p<.001$). For patients treated with RFA, complete eradication of dysplasia during follow-up was 98.4% and the absence of metaplasia was 90.0%. There were 3 serious adverse events in 2 patients who received RFA (1 case each of abdominal pain requiring hospitalization, bleeding, fever/chills following dilation for stricture), and 12 other adverse events (8 strictures requiring dilation, 3 mucosal lacerations, 1 retrosternal pain).

The long-term follow-up results of the Phoa et al. (2014) study were reported in Pouw et al. (2020). After a median follow-up of 73 months, no additional patients showed progression to HGD in the RFA group from the original study, while 5 additional patients in the surveillance group progressed to HGD (n=4) or intramucosal cancer (n=1). Overall, during the initial study period and long-term follow-up, progression to HGD/cancer was observed in 1.5% of patients in the RFA group compared to 33.8% in the surveillance group, translating to a number needed to treat of 3.1 (95% CI, 2.3 to 4.5). Of the 83 patients treated with RFA (68 patients in the original study plus 15 patients in the original surveillance group who received RFA after study closure), 75 (90%) achieved complete clearance of BE and dysplasia.

Section Summary: Radiofrequency Ablation for Barrett Esophagus with Low-Grade Dysplasia

The risk of progression from LGD to cancer is not well-defined, with highly variable rates reported in the published literature. Evidence from randomized and nonrandomized studies has established that RFA can achieve complete eradication of dysplasia in patients with LGD that is durable for at least 2 years. One RCT of 136 subjects reported a lower rate of progression to HGD or adenocarcinoma for patients who had confirmed LGD treated with RFA. This trial supported the strategy of selecting a population at a higher risk of progression by subjecting the initial pathologic diagnosis of LGD to review by an expert in GI pathology. The expert review has reduced the number of patients diagnosed with LGD by 50% to 75%, presumably by reducing the number of patients with inflammatory changes who are miscategorized as having LGD.

Radiofrequency Ablation for Barrett Esophagus Without Dysplasia

Clinical Context and Therapy Purpose

The purpose of endoscopic RFA in patients who have BE without dysplasia is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does the use of RFA improve the net health outcome in patients with BE without dysplasia?

The following PICO was used to select literature to inform this review.

Populations

The relevant population of interest is patients with BE without dysplasia.

Interventions

The therapy being considered is endoscopic RFA.

Comparators

The following practice is currently being used to treat BE without dysplasia: surveillance by gastroenterologists.

Outcome

The general outcomes of interest are symptoms (e.g., pain) and functional outcomes (including swallowing).

Beneficial outcomes include reductions in progression to dysplasia or carcinoma and longer-term maintenance of eradication of dysplasia.

Harmful outcomes include damage to the esophagus resulting in difficulty swallowing. Morbidity would be assessed within 30 days after the procedure. Conversion to dysplasia would be measured at 2 to 5 years.

Study Selection Criteria

Methodologically credible studies were selected using the following principles:

- To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
- In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
- To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.

Nonrandomized Trials

No RCTs were identified that evaluated RFA treatment of BE without dysplasia. The evidence on this issue consists of single-arm trials that have reported outcomes of RFA. There is no high-quality evidence on the comparative efficacy of RFA versus surveillance alone. Progression to cancer in cases of nondysplastic BE is lower than that for LGD or HGD, with rates in the literature ranging from 0.05% to 0.5%.

Fleischer et al. (2008, 2010) reported on the 5-year follow-up of a single-arm study of patients with nondysplastic BE treated with RFA. The original study included 70 patients who underwent circumferential RFA and CR-IM, defined as complete eradication of nondysplastic BE. CR-IM was seen in 70% of patients at 1-year follow-up; patients with persistent BE underwent focal RFA. At the 2.5-year follow-up, CR-IM was found in 60 (98%) of 61 patients. At 5-year follow-up, 4-quadrant biopsies were obtained from every 1 cm of the original extent of BE, and the authors reported the proportion of patients demonstrating CR-IM. If nondysplastic BE was identified at the 5-year follow-up, focal RFA was performed 1 month later, and biopsies were repeated 2 months afterward to assess histologic response. Primary outcomes were the proportion of patients demonstrating CR-IM at a 5-year biopsy or after a single session of focal RFA. For the 5-year follow-up, there were 60 eligible patients, 50 (83%) of whom participated. Forty-six (92%) of 50 patients showed CR-IM at the 5-year biopsy visit. The 4 patients found to have BE at 5 years underwent a single session of RFA 1 month after biopsy; all 4 patients had CR-IM at subsequent rebiopsy 2 months after RFA. No strictures were noted. The authors concluded that this first report of 5-year CR-IM outcomes supported the safety, efficacy, and reduction in neoplastic progression in treating nondysplastic BE with RFA.

Section Summary: Radiofrequency Ablation for Barrett Esophagus Without Dysplasia

Nondysplastic BE has a relatively low rate of progression to cancer. Although available research has indicated that nondysplastic metaplasia can be eradicated by RFA, the risk-benefit ratio and the net effect on health outcomes is uncertain.

Cryoablation of Barrett Esophagus

Clinical Context and Therapy Purpose

The purpose of endoscopic cryoablation in patients who have BE is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does the use of cryoablation improve the net health outcome in patients with BE?

The following PICO was used to select literature to inform this review.

Populations

The relevant population of interest is patients with BE with or without dysplasia.

Interventions

The therapy being considered is endoscopic cryoablation.

Comparators

The following therapies and practices are currently being used to treat BE: esophagectomy, EMR, and surveillance.

Outcomes

The general outcomes of interest are symptoms (eg, pain) and functional outcomes (including swallowing).

Beneficial outcomes include reductions in progression to HGD or carcinoma and longer-term maintenance of eradication or dysplasia.

Harmful outcomes include damage to the esophagus resulting in difficulty swallowing. Morbidity would be assessed within 30 days after the procedure.

Study Selection Criteria

Methodologically credible studies were selected using the following principles:

- To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
- In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
- To assess long-term outcomes and adverse events, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.

Systematic Reviews

Several meta-analyses have evaluated the efficacy of cryotherapy in patients with BE (Tables 1, 2, and 3). Tariq et al. (2021) performed a meta-analysis of 14 retrospective and prospective observational studies (N=405) of patients with BE who were treated with cryotherapy. The primary outcome of proportions of patients achieving complete eradication of dysplasia and complete eradication of intestinal metaplasia were 84.8% (95% CI, 72.2% to 94.4%) and 64.2% (95% CI, 52.9% to 74.8%), respectively. Both outcomes had a high degree of heterogeneity (I^2 of 88.3% and 77.9%, respectively). Subgroup analyses of only high-quality studies revealed rates of 91.3% (95% CI, 83.0% to 97.4%; $I^2=69.5$) and 71.6% (95% CI, 59.0% to 82.9%, $I^2=80.9\%$), respectively. In their meta-analysis, Westerveld et al. (2020) evaluated 7 prospective and retrospective cohort studies that reported outcomes of balloon cryoablation across 272 patients with BE; 3 of the included studies were previously reported in abstract form only. The pooled proportion for complete eradication of intestinal metaplasia was 85.8% (95% CI, 77.8% to 92.2%). Among 262 patients with BE with dysplasia, 238 reported complete eradication of dysplasia after cryoablation (pooled proportion, 93.8%; 95% CI, 85.5% to 98.7%). Both outcomes had a high degree of heterogeneity (I^2 of 55% and 74.2%, respectively). However, when 2 low quality studies were excluded from the analysis results were consistent with the primary analysis. Adverse events were reported in 12.5% of patients, representing 34 adverse events. Half of the adverse events (n=16) were post-ablation stricture formation (5.8%).

Hamade et al. (2019) evaluated the use of cryotherapy for BE in patients who were previously treatment naive. Six uncontrolled trials were included in the systematic review, which included 232 patients overall. Complete eradication of intestinal metaplasia was achieved in 69.35% of cases (95% CI, 52.1% to 86.5%; $I^2 = 89.3\%$). Complete eradication of dysplasia was achieved in 90.6% of cases (95% CI, 83.7% to 97.4%; $I^2 = 75.7\%$). Progression to cancer occurred in 4% of cases (9/225). The pooled recurrence rate of intestinal metaplasia was 19.1 per 100 patient-years. The post-procedure stricture formation rate was 4.9% and 3.9% of patients reported postprocedural pain.

Table 1. Comparison of Studies Included in SR & M-As

Study	Tariq et al. (2020)	Westerveld et al. (2020)	Hamade et al. (2019)
Canto et al. (2019)		●	
Canto et al. (2018)	●	●	●
Canto et al. (2015)	●		●
Cheng et al. (2013)	●		
Eluri et al. (2017)	●		

Goldberg et al. (2012)	●		
Gosaine et al. (2013)	●		●
Greenwald et al. (2010)	●		
Halsey et al. (2011)	●		
Johnston et al. (2013)	●		
Kunzli et al. (2016)		●	
Ramay et al. (2017)	●		●
Scholvinck et al. (2015)		●	
Sitaraman et al. (2016)		●	
Trindade et al. (2017)	●		●
Thota et al. (2018)	●		●
Van Munster et al. (2018)		●	
Verbeek et al. (2015)	●		
Wang et al. (2015)		●	
Wani et al. (2012)	●		

M-A: meta-analysis; SR: systematic review.

Table 2. SR & M-A Characteristics

Study	Dates	Trials	Participants	N (Range)	Design	Duration
Tariq et al. (2020)	2006-2016	14	Patients with biopsy-confirmed dysplastic or neoplastic BE who underwent ≥ 1 session of cryotherapy	405 (20-81)	Retrospective, prospective observational	Range, 3-54 months

Westerveld et al. (2020)	2015-2019	7	Patients with BE treated with cryoablation	272 (5-120)	Retrospective, prospective observational	NR
Hamade et al. (2019)	NR	6	Treatment-naive patients with BE treated with cryotherapy	282 (22-81)	Retrospective observational	Range, 24 to 65 months

BE: Barrett's esophagus; NR: not reported; M-A: meta-analysis; SR: systematic review.

Table 3. SR & M-A Results

Study	Complete eradication of dysplasia	Complete eradication of intestinal metaplasia
Tariq et al. (2020)		
Total N	405	393
Pooled effect (95% CI)	84.8% (72.2-94.4)	64.2% (52.9-74.8)
I^2 (%)	88.3	77.9
Westerveld et al. (2020)		
Total N	262	272
Pooled effect (95% CI)	93.8% (85.5-98.7)	85.8% (77.8-92.2%)
I^2 (%)	74.2	55
Hamade et al (2019)		
Total N	282	282
Pooled effect (95% CI)	90.6 (83.7-97.4)	69.35 (52.1-86.5)
I^2 (%)	75.7	89.3

CI: confidence interval; M-A: meta-analysis; SR: systematic review.

Prospective and Retrospective Studies

Several small prospective and retrospective uncontrolled studies of cryoablation studies have been published (See the tables below). These studies are heterogenous in the proportion of patients with prior BE treatment, cryoablation techniques used, and follow-up duration. Below is a summary of studies that were not included in the above-described systematic reviews and/or have notable characteristics (*i.e.*, focus on subpopulations, have long-term follow-up).

A retrospective, single-center study by Sengupta et al. (2015) evaluated cryoablation among 16 patients who failed RFA. The cohort of 16 patients was derived from an original cohort of 121 patients who underwent RFA for BE with LGD, HGD, or intramucosal carcinoma. After a median of 3 treatments with RFA, 91 subjects had complete eradication of dysplasia. Of 21 patients offered cryotherapy, 16 underwent cryotherapy and had an adequate follow-up. Fourteen of those who did not have complete eradication and 2 who had a recurrence of dysplasia underwent salvage cryotherapy. Over a median follow-up of 2.5 months, and with a median of 3 cryotherapy treatments, 12 (75%) patients had complete eradication of dysplasia after cryotherapy, and 14 (88%) had some improvement in pathology after cryotherapy.

Shaheen et al. (2010) reported on a multicenter, retrospective cohort study that assessed the safety and efficacy of spray cryotherapy in 98 consecutive patients who had BE with HGD. A total of 333 cryotherapy treatments (mean 3.4 per patient) were performed, all with the intent to eradicate all BE. Sixty patients completed all planned cryotherapy treatments and were assessed for efficacy at follow-up endoscopy sessions with 4-quadrant biopsies performed every 1 to 2 cm. Fifty-eight (97%) patients had complete eradication of HGD, (87%) had complete eradication of all dysplasia with persistent nondysplastic intestinal metaplasia, and 34 (57%) had complete eradication of all intestinal metaplasia. There were no esophageal perforations, and esophageal stricture occurred in 3 patients. The authors noted several study limitations: it was nonrandomized and retrospective without a control group, it lacked centralized pathology, it used surrogate outcomes for decreased cancer risk, and it had a short follow-up (10.5 months). An open-label, single-center, prospective, nonrandomized cohort study by Dumot et al. (2009) assessed the safety of cryoablation as a treatment option for BE with HGD or intramucosal carcinoma. Thirty patients who were either deemed high-risk surgical candidates or who refused esophagectomy underwent cryoablation. Twenty-seven (90%) patients had their pathology stage downgraded after treatment. After a median follow-up of 12 months, elimination of cancer or downgrading of HGD was 68% for HGD and 80% for intramucosal carcinoma. The authors noted the heterogeneous nature of the patient sample (high-risk, nonsurgical group of patients), which limited generalizability to patients in most BE ablation trials.

Summary of Key Nonrandomized Studies

Study	Study Type	Country	Dates	Participants	Treatment	Follow-Up
Sengupta et al. (2015)	Retrospective, observational	US	2006-2013	Patients who underwent RFA for BE with LGD, HGD, or intramucosal carcinoma	Cryoablation	Median, 2.5 months

Shaheen et al. (2010)	Retrospective, observational	US	2007-2009	Patients who had BE with HGD	Cryoablation	Mean, 10.5 months
Dumot et al. (2009)	Prospective, observational	US	2005-2008	Patients who had BE with HGD or intramucosal carcinoma	Cryoablation	Median, 12 months

BE: Barrett's esophagus; HGD: high-grade dysplasia; LGD: low-grade dysplasia; RFA: radiofrequency ablation.

Summary of Key Nonrandomized Study Results

Study	Complete eradication of dysplasia	Complete eradication of intestinal metaplasia	Downgrading of pathology stage	Elimination of cancer or downgrading of HGD
Sengupta et al. (2015)	N=121			
Cryotherapy, n (%)	91 (75)	NR	NR	NR
Shaheen et al. (2010)	N=60	N=60		
Cryotherapy, n (%)	58 (97)	34 (57)	NR	NR
Dumot et al. (2009)			N=30	N=30
Cryotherapy, n (%)	NR	NR	27 (90)	Patients with HGD: 20 (68) Patients with intramucosal carcinoma: 24 (80)

HGD: high-grade dysplasia; NR: not reported.

Section Summary: Cryoablation of Barrett Esophagus

No controlled trials have evaluated cryoablation for the treatment of BE. The evidence from uncontrolled studies has reported high rates of success in eradicating dysplasia, with low rates of complications. These data are not sufficient to determine the comparative efficacy of cryoablation and RFA.

Summary of Evidence

For individuals who have BE with HGD who receive endoscopic RFA, the evidence includes a RCT comparing radical endoscopic resection with focal endoscopic resection followed by RFA, an RCT comparing RFA with surveillance alone, and a systematic review evaluating RCTs and a number of observational studies, some of which compared RFA with other endoscopic treatment modalities. Relevant outcomes are change in

disease status, morbid events, and treatment-related morbidity and mortality. The available evidence has shown that using RFA to treat BE with HGD is at least as effective in eradicating HGD as other ablative techniques, with a lower progression rate to cancer, and may be considered an alternative to esophagectomy. Evidence from at least 1 RCT has demonstrated higher rates of eradication than surveillance alone. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have BE with LGD who receive endoscopic RFA, the evidence includes at least 2 RCTs comparing RFA with surveillance alone, a number of observational studies, and systematic reviews of these studies. Relevant outcomes are change in disease status, morbid events, and treatment-related morbidity and mortality. For patients with confirmed LGD, evidence from an RCT has suggested that RFA reduces progression to HGD and adenocarcinoma. Challenges exist in differentiating between nondysplastic BE and BE with LGD; thus, a correct diagnosis has important implications for LGD treatment decisions. One of the available RCTs required that LGD be confirmed by an expert panel, which supports the use of having a gastrointestinal pathologist confirm LGD before treatment of BE with LGD can begin. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have BE without dysplasia who receive endoscopic RFA, the evidence includes single-arm studies reporting outcomes after RFA. Relevant outcomes are change in disease status, morbid events, and treatment-related morbidity and mortality. The available studies have suggested that nondysplastic metaplasia can be eradicated by RFA. However, the risk-benefit ratio and the net effect of RFA on health outcomes are unknown. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have BE with or without dysplasia who receive endoscopic cryoablation, the evidence includes noncomparative studies and systematic reviews of those studies reporting outcomes after cryoablation. Relevant outcomes include change in disease status, morbid events, and treatment-related morbidity and mortality. These studies have generally demonstrated high rates of eradication of dysplasia. However, the available evidence does not compare cryoablation with surgical care or RFA. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Summary of Evidence: Cryoablation

For individuals who have BE with or without dysplasia who receive endoscopic cryoablation, the evidence includes noncomparative studies and systematic reviews of those studies reporting outcomes after cryoablation. Relevant outcomes include change in disease status, morbid events, and treatment-related morbidity and mortality. These studies have generally demonstrated high rates of eradication of dysplasia. However, the

available evidence does not compare cryoablation with surgical care or RFA. The evidence is insufficient to determine the effects of technology on net health outcomes.

Radiofrequency Ablation (RFA): High Grade Dysplasia

(2014) Chadwick et al. reported on a systematic review that compared RFA with complete endoscopic mucosal resection (EMR) for the treatment of BE. Twenty studies (22 articles) were reviewed, including 2 RCTs, 10 cohort studies on EMR, and 8 cohort studies on RFA. The only study that compared RFA with EMR was an RCT by van. The studies were heterogeneous in design. A total of 1,087 (532 EMR, 555 RFA) patients with HGD or intramucosal carcinoma were included in the studies reviewed. The median number of resections or RFA sessions required for the eradication of BE was two. Complete EMR and RFA eradicated BE dysplasia in 95% and 92% of patients, respectively. Eradication was maintained in 95% of EMR patients at a median follow-up of 23 months and in 94% of RFA patients at a median follow-up of 21 months. Fewer RFA patients experienced short-term adverse events (2.5%) than those who received complete EMR (12%). Esophageal strictures requiring additional treatment occurred in 4% of RFA patients and 38% of complete endoscopic resection patients.

(2011) Shaheen et al. noted longer-term follow-up at 2 to 3 years reported that complete eradication of dysplasia was maintained in most participants with initial HGD. For 54 patients with HGD available for follow-up, all dysplasia was eradicated in 50 (93%) of 54, and all intestinal metaplasia was eradicated in 48 (89%) of 54. After 3 years, dysplasia was eradicated in 55 (98%) of 56 of subjects, and all intestinal metaplasia was eradicated in 51 (91%) of 56. More than 75% of patients with HGD remained free of intestinal metaplasia with a follow-up of longer than 3 years, with no additional therapy.

(2009) Shaheen et al compared RFA with surveillance alone in patients with BE and dysplasia. RFA was successful in eradicating HGD, with complete eradication at 12 months achieved in 81% of the ablation group versus 19% in the control group ($p < 0.001$). This trial also confirmed a high-risk of progression to cancer in patients with HGD and established that this progression was significantly reduced in patients treated with RFA. Among 63 patients with HGD in the trial, 19% in the control group progressed to cancer versus 2.4% in the RFA group ($p = 0.04$). This represented a nearly 90% relative risk reduction for progression to cancer (relative risk, 0.1; 95% confidence interval [CI], 0.01 to 1.0, $p = 0.04$), and a number needed to treat of 6.0 to prevent 1 case of cancer over a 1-year period.

Radiofrequency Ablation (RFA): Low Grade Dysplasia

(2018) Pandey et al evaluated RCTs and observational studies to determine the efficacy of RFA in treating BE with LGD compared with surveillance. The 8 studies in the meta-analysis included 619 patients followed up for a median of 26 months. The overall pooled rate of complete eradication of intestinal metaplasia after RFA was 88.17% (95% CI, 88.13% to 88.20%; $p < 0.001$); the rate of complete eradication of dysplasia was 96.69% (95% CI, 96.67% to 96.71%; $p < 0.001$). Compared with surveillance, the rates of progression to high-grade dysplasia or cancer were significantly lower with RFA (odds

ratio 0.07; 95% CI, 0.02 to 0.22). The pooled recurrence rate of intestinal metaplasia was 5.6% (95% CI, 5.57% to 5.63%; $p < 0.001$) and 9.66% (95% CI, 9.61% to 9.71%; $p < 0.001$) for dysplasia. Although the analysis was limited by its inclusion of observational cohort studies and the sample sizes of patients receiving RFA were all less than 100 patients, all studies supported the use of RFA for LGD BE. The authors concluded that RFA is safe and effective for eradicating intestinal metaplasia and dysplasia and reducing progression from LDG to HGD or cancer in the short term. Longer-term outcomes, however, warrant further research.

(2014) Almond et al reported on the results of a meta-analysis of studies using endoscopic therapy to treat BE with LGD. The analysis included 37 studies, 9 of which evaluated RFA alone, including the RCT by Shaheen et al (2009). Most studies were small, with the Shaheen et al (2009) RCT representing the largest study (52 with LGD treated with RFA). For patients treated with RFA, the pooled incidence of cancer or progression to HGD was 10.77 per 1000 patient-years (95% CI, 2.22 to 31.48 per 1000 patient-years). For RFA-treated patients, pooled rates of complete eradication of intestinal metaplasia and complete eradication of dysplasia were 87.2% (95% CI, 76.2% to 93.5%) and 90.6% (95% CI, 81.0% to 95.6%), respectively.

Radiofrequency Ablation (RFA) without Dysplasia:

No RCTs were identified that evaluated RFA treatment of BE without dysplasia. The evidence on this issue consists of single-arm trials that have reported outcomes of RFA. There is no high-quality evidence on the comparative efficacy of RFA versus surveillance alone. Progression to cancer in cases of nondysplastic BE is lower than that for LGD or HGD, with rates in the literature ranging from 0.05% to 0.5%.

(2008, 2010) Fleischer et al. reported on the 5-year follow-up of a single-arm study of patients with nondysplastic BE treated with RFA. The original study included 70 patients who underwent circumferential RFA and CR-IM, defined as complete eradication of nondysplastic BE. CR-IM was seen in 70% of patients at 1-year follow-up; patients with persistent BE underwent focal RFA. At the 2.5-year follow-up, CR-IM was found in 60 (98%) of 61 patients at 5-year follow-up, 4-quadrant biopsies were obtained from every 1 cm of the original extent of BE, and the authors reported the proportion of patients demonstrating CR-IM. If nondysplastic BE was identified at the 5 year follow-up, focal RFA was performed 1 month later, and biopsies were repeated 2 months afterward to assess histologic response. Primary outcomes were the proportion of patients demonstrating CR-IM at a 5-year biopsy or after a single session of focal RFA. For the 5-year follow-up, there were 60 eligible patients, 50 (83%) of whom participated. Forty-six (92%) of 50 patients showed CR-IM at the 5-year biopsy visit. The 4 patients found to have BE at 5 years underwent a single session of RFA 1 month after biopsy; all 4 patients had CR-IM at subsequent re-biopsy 2 months after RFA. No strictures were noted. The authors concluded that this first report of 5-year CR-IM outcomes supported the safety, efficacy, and reduction in neoplastic progression in treating nondysplastic BE with RFA.

Summary of Evidence: Radiofrequency Ablation (RFA)

For individuals who have BE with high-grade dysplasia (HGD) who receive endoscopic RFA, the evidence includes a randomized controlled trial (RCT) comparing radical endoscopic resection with focal endoscopic resection followed by RFA, an RCT comparing RFA with surveillance alone, and a systematic review evaluating RCTs and a number of observational studies, some of which compared RFA with other endoscopic treatment modalities. Relevant outcomes are change in disease status, morbid events, and treatment-related morbidity and mortality. The available evidence has shown that using RFA to treat BE with HGD is at least as effective in eradicating HGD as other ablative techniques, with a lower progression rate to cancer, and may be considered an alternative to esophagectomy. Evidence from at least 1 RCT has demonstrated higher rates of eradication than surveillance alone. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have BE with low-grade dysplasia (LGD) who receive endoscopic RFA, the evidence includes at least 2 RCTs comparing RFA with surveillance alone, a number of observational studies, and systematic reviews of these studies. The risk of progression from LGD to cancer is not well-defined, with highly variable rates reported in the published literature. Relevant outcomes are change in disease status, morbid events, and treatment-related morbidity and mortality. For patients with confirmed LGD, evidence from an RCT has suggested that RFA reduces progression to HGD and adenocarcinoma. Challenges exist in differentiating between nondysplastic BE and BE with LGD; thus, a correct diagnosis has important implications for LGD treatment decisions. One of the available RCTs required that LGD be confirmed by an expert panel, which supports the use of having a gastrointestinal pathologist confirm LGD before treatment of BE with LGD can begin. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have BE without dysplasia who receive endoscopic RFA, the evidence includes single-arm studies reporting outcomes after RFA. Relevant outcomes are change in disease status, morbid events, and treatment-related morbidity and mortality. The available studies have suggested that nondysplastic metaplasia can be eradicated by RFA. However, the risk-benefit ratio and the net effect of RFA on health outcomes are unknown. The evidence is insufficient to determine the effects of technology on net health outcomes.

Practice Guidelines and Position Statements

American College of Gastroenterology (ACG)

In 2016, the American College of Gastroenterology issued guidelines on the diagnosis and management of BE, which made statements about endoscopic therapies in general, as outlined in the table below.

Guidelines on the Diagnosis and Management of Barrett Esophagus

Recommendation	SOR	LOE
Patients with nodularity in the BE segment should undergo endoscopic mucosal resection of the nodular lesion(s) as the initial diagnostic and therapeutic maneuver.... Histologic assessment of the EMR specimen should guide further therapy. In subjects with EMR specimens demonstrating HGD or IMC, endoscopic ablative therapy of the remaining BE should be performed.	Strong	High
In patients with EMR specimens demonstrating neoplasia at a deep margin, residual neoplasia should be assumed, and surgical, systemic, or additional endoscopic therapies should be considered	Strong	Low
Endoscopic ablative therapies should not be routinely applied to patients with nondysplastic BE because of their low risk of progression to EAC. Endoscopic eradication therapy is the procedure of choice for patients with confirmed LGD, and confirmed HGD, as noted above	Strong	Very low
In patients with T1a EAC, endoscopic therapy is the preferred therapeutic approach, being both effective and well-tolerated	Strong	Moderate
In patients with T1b EAC, consultation with multidisciplinary surgical oncology team should occur before embarking on endoscopic therapy. In such patients, endoscopic therapy may be an alternative strategy to esophagectomy, especially in those with superficial (sm1) disease with a well-differentiated neoplasm lacking lymphovascular invasion, as well as those who are poor surgical candidates	Strong	Low
Routine staging of patients with nodular BE with EUS or other imaging modalities before EMR has no demonstrated benefit. Given the possibility of over- and understaging, findings of these modalities should not preclude the performance of EMR to stage-early neoplasia	Strong	Moderate
In patients with known T1b disease, EUS may have a role in assessing and sampling regional lymph nodes, given the increased prevalence of lymph node involvement in these patients compared with less advanced disease	Strong	Moderate
In patients with dysplastic BE who are to undergo endoscopic ablative therapy for nonnodular disease, radiofrequency ablation is currently the preferred endoscopic ablative therapy	Strong	Moderate

American Gastroenterological Association (AGA)

In 2020, the American Gastroenterological Association published a best practice clinical update on the role of endoscopic therapy in patients with BE with dysplasia and/or early

cancer. This best practice document was not based on a formal systematic review; thus, no ratings for strength of recommendation and quality of evidence were not provided. For BE with LGD, best practice advice included the following:

- "The reading of LGD in BE should be confirmed by an experienced gastrointestinal pathologist."
- "In BE patients with confirmed LGD, a repeat examination within 3–6 months with HD-WLE [high-definition white-light endoscopy] and preferably optical chromoendoscopy should be performed to rule out the presence of a visible lesion, which should prompt endoscopic resection (see section on HGD)."
- "Both BET [Barrett's endoscopic therapy] and continued surveillance are reasonable options for the management of BE patients with confirmed and persistent LGD."

For BE with HGD, best practice advice included the following:

- "The reading of HGD in BE should be confirmed by an experienced gastrointestinal pathologist."
- "The diagnosis of flat HGD should prompt a repeat HD-WLE (6–8 weeks) to evaluate for the presence of a visible lesion; these visible lesions should be removed by EMR [endoscopic mucosal resection]."
- "BET is the preferred treatment, over esophagectomy, for BE patients with HGD."

(Accessed October 2022)

American Society for Gastrointestinal Endoscopy

In 2018, the American Society for Gastrointestinal Endoscopy issued guidelines on the role of endoscopy in BE-associated dysplasia and intramucosal cancer. These guidelines made the following recommendations on endoscopic eradication therapy, consisting of endoscopic mucosal resection of visible lesions and ablative techniques that include RFA and cryotherapy (see the Table Below).

Guidelines on Use of Endoscopy for Barrett Esophagus and Intramucosal Cancer

Recommendation	SOR	QOE^a
In BE patients with LGD and HGD being considered for EET, we suggest confirmation of diagnosis by at least 1 expert GI pathologist or panel of pathologists compared with review by a single pathologist.	Conditional	Low
In BE patients with LGD, we suggest EET compared with surveillance; however, patients who place a high value on avoiding adverse events related to EET may choose surveillance as the preferred option.	Conditional	Moderate
In BE patients with confirmed HGD, we recommend EET compared with surveillance	Strong	Moderate

Recommendation	SOR	QOE^a
In BE patients with HGD/IMC, we recommend against surgery compared with EET	Strong	Very low quality
In BE patients referred for EET, we recommend endoscopic resection of all visible lesions compared with no endoscopic resection of visible lesions.	Strong	Moderate
In BE patients with visible lesions who undergo endoscopic resection, we suggest ablation of the remaining Barrett's segment compared with no ablation.	Conditional	Low
In BE patients with dysplasia and IMC referred for EET, we recommend against routine complete endoscopic resection of entire Barrett's segment compared with endoscopic resection of visible lesion followed by ablation of remaining Barrett's segment.	Strong	Very low
In BE patients with dysplasia and IMC who have achieved CE-IM after EET, we suggest surveillance endoscopy versus no surveillance.	Conditional	Very low

BE: Barrett esophagus; CE-IM: complete eradication of intestinal metaplasia; EET: endoscopic eradication therapy; HGD: high-grade dysplasia; LGD: low-grade dysplasia; IMC: intramucosal cancer; QOE: quality of evidence; SOR: strength of recommendation.

^a Quality assessed using GRADE system.

(Accessed October 2022)

National Comprehensive Cancer Network (NCCN)

Esophageal and Esophagogastric Junction Cancers Guideless (Version 4.2022) states the following:

- **Diagnosis**
 - The location of the tumor relative to the teeth and EGJ, the length of the tumor, the extent of circumferential involvement, and the degree of obstruction should be carefully recorded to assist with treatment planning. If present, the location, length, and circumferential extent of Barrett esophagus should be characterized in accordance with Prague criteria and mucosal nodules should be carefully documented. ER, either by endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD), followed by RFA has become the standard treatment for most patients with Barrett esophagus and HGD. Alternative strategies include cryoablation or photodynamic therapy (PTD).
 - Endoscopic resection (ER) of focal nodules should be performed in the setting of early-stage disease to provide accurate depth of invasion, degree of differentiation, and the presence of vascular and/or lymphatic invasion. ER should be considered in the evaluation of areas of Barrett esophagus associated with high-grade dysplasia (HGD) and also patches of squamous cell dysplasia, specifically focusing on areas of nodularity or ulceration.

Pathologists should be asked to provide an assessment of the depth of tumor infiltration into the lamina propria, muscularis mucosa, and submucosa; invasion of vascular structures and nerves; and the presence of tumor or dysplastic cells at the lateral and deep margins. ER may be fully therapeutic when a lesion is fully removed and histopathologic assessment demonstrates extension no deeper than the superficial submucosa and negative deep margins; however patients with poorly differentiated tumors, deep submucosal invasion, and/or lymphovascular invasion (LVI) are at significantly higher risk of lymph node involvement.

- Endoscopic Therapies
 - Endoscopic therapies including ER (EMR or ESD) and endoscopic ablation (cryoablation or RFA) have been used as alternatives to surgery for the treatment of early-stage esophageal and EGJ cancers, with much less treatment-related morbidity than surgical resection.
 - Endoscopic cryoablation has also been reported to be safe and well-tolerated in patients with Barrett esophagus and early-stage esophageal cancers.
- Post-Treatment Surveillance
 - Endoscopic surveillance should also include a search for the presence of Barrett esophagus and four-quadrant biopsies to detect residual or recurrent dysplasia. The ablation of residual or recurrent high-grade and low-grade dysplasia using RFA or cryoablation should be considered.
- Surveillance
 - Endoscopic surveillance should include a search for the presence of Barrett esophagus and four-quadrant biopsies to detect residual or recurrent dysplasia. The ablation of residual or recurrent HGD and LGD using RFA or cryoablation should be considered. Ablation of non-dysplastic Barrett esophagus is not recommended.

(Accessed October 2022)

National Institute for Health and Clinical Excellence (NICE)

(2010, Updated 2014) Issued guidance on Epithelial radiofrequency ablation for Barrett's esophagus

- Current evidence on the efficacy of epithelial radiofrequency ablation (RFA) in patients with Barrett's esophagus with high-grade dysplasia (HGD) is adequate, provided that patients are followed up in the long term. There are no major safety concerns. Therefore, this procedure may be used in patients with Barrett's esophagus with HGD provided that normal arrangements are in place or clinical governance, consent, and audit.
- NICE encourages further research into epithelial RFA for Barrett's esophagus. This should address the balance of risks and benefits of the procedure in patients with Barrett's esophagus and either LGD or no dysplasia, and long-term outcomes in patients with Barrett's esophagus of any histological type. *(Accessed October 2022)*

(2014) Issued recommendations on Endoscopic radiofrequency ablation for Barrett's esophagus with low-grade dysplasia or no dysplasia which stated the following information:

- Current evidence on the efficacy of endoscopic radiofrequency ablation for Barrett's esophagus with low-grade dysplasia is adequate provided that patients are followed up in the long term. There are no major safety concerns. Therefore, this procedure may be used in patients with Barrett's esophagus with low-grade dysplasia with normal arrangements for clinical governance, consent and audit or research.
- Current evidence on the efficacy and safety of endoscopic radiofrequency ablation for Barrett's esophagus with no dysplasia is limited in quality and quantity. Therefore, this procedure should only be used in patients with no dysplasia in the context of research.
- Patient selection for endoscopic radiofrequency ablation for Barrett's esophagus with low-grade dysplasia should be done by a multidisciplinary team experienced in managing Barrett's esophagus, as described in the British Society of Gastroenterology guidelines.
- Endoscopic radiofrequency ablation for Barrett's esophagus with low-grade dysplasia should only be done by endoscopists experienced in treating Barrett's esophagus, as described in the British Society of Gastroenterology guidelines.
- Clinicians should enter details of all patients undergoing endoscopic radiofrequency ablation for Barrett's esophagus with low-grade dysplasia or no dysplasia onto the UK National HALO Patient Registry and review clinical outcomes locally.

(Accessed October 2022)

Society of Thoracic Surgeons (STS)

(In 2010, the Society of American Gastrointestinal and Endoscopic Surgeons published guidelines on the surgical treatment of gastroesophageal reflux disease, which included recommendations for the treatment of BE (see the table below).

Guidelines on Surgical Treatment of Gastroesophageal Reflux Disease

Recommendation	GOR
HGIN and IMC can be effectively treated with endoscopic therapy including PDT, EMR, and RFA, alone or in combination.	B
Antireflux surgery may be performed in a patient with non-neoplastic IM, IND, or LGIN, with or without endoscopic therapy to eradicate Barrett's tissue. Specifically, RFA has been shown to be safe, clinically effective, and cost-effective in these disease states and may be performed in eligible patients before, during, or after antireflux surgery.	B

(Accessed October 2022)

Regulatory Status

In 2007, the CryoSpray Ablation™ System (formerly the SprayGenix Cryo Ablation system; CSA Medical) was cleared for marketing by the FDA through the 510(k) process for use as a “cryosurgical tool for destruction of unwanted tissue in the field of general surgery, specifically for endoscopic applications.” The CryoBalloon Ablation System has also been cleared by the FDA through the 510(k) process for use as a cryosurgical tool in surgery for endoscopic applications, including ablation of BE with dysplasia.
FDA product code: GEH.

In 2005, the HALO360 (now Barrx™ 360 RFA Balloon Catheter; Barrx Medical; acquired by Covidien in 2012) was cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process and, in 2006, the HALO90 (now Barrx™ 90 RFA Focal Catheter) received clearance. The FDA labeled indications are for use in coagulation of bleeding and nonbleeding sites in the gastrointestinal tract and include the treatment of BE. Other focal ablation devices from Barrx include the Barrx™ 60 RFA Focal Catheter, the Barrx™ Ultra Long RFA Focal Catheter, the Barrx™ Channel RFA Endoscopic Catheter.
FDA product code: GEI.

In 2002, the Polar Wand® device (Chek-Med Systems), a cryosurgical device that uses compressed carbon dioxide, was cleared for marketing by the FDA through the 510(k) process. Indications for use are “ablation of unwanted tissue in the fields of dermatology, gynecology, general surgery, urology, and gastroenterology.”

PRIOR APPROVAL

Not Applicable

POLICY

See Related Medical Policies

- [02.01.23 Treatment for Gastroesophageal Reflux Disease \(GERD\)](#)
- [02.04.81 Biomarker Testing for Barrett’s Esophagus and Other Esophageal Disorders](#)
- 02.01.66 Confocal Laser Endomicroscopy

Medically Necessary

Radiofrequency ablation may be considered **medically necessary** for the treatment of Barrett esophagus (BE) with high-grade dysplasia (see Policy Guidelines section).

Radiofrequency ablation may be considered **medically necessary** for the treatment of Barrett esophagus (BE) with low-grade dysplasia when the initial diagnosis of low-grade dysplasia is confirmed by two pathologists. (see Policy Guidelines section).

Investigational

Radiofrequency ablation is considered investigational for the treatment of BE when the above criteria are not met, including but not limited to BE in the absence of dysplasia.

Cryoablation is considered investigational for the treatment of BE, with or without dysplasia.

Policy Guidelines

Radiofrequency Ablation for Barrett Esophagus with High-Grade Dysplasia (HGD)

- Radiofrequency ablation for Barrett esophagus with high-grade dysplasia (HGD) may be used in combination with endoscopic mucosal resection (EMR) of nodular or visible lesions. The diagnosis of HGD should be confirmed by 2 pathologists before initiating radiofrequency ablation.
- The American Society for Gastrointestinal Endoscopy and the American Gastroenterological Association both recommend that a reading of HGD should be confirmed by an experienced gastrointestinal pathologist.
- Two cohort studies found that reevaluation of HGD after an initial evaluation resulted in 40% to 53% of patients receiving a lower-grade evaluation on repeat endoscopy, highlighting the need for confirmation by an expert center.
- Additionally, for HGD, it is important to rule out adenocarcinoma; referral to an expert center that can conduct high-definition white-light endoscopy and other diagnostic techniques has been found to increase the rate of adenocarcinoma detection and proper referral for EMR.

Radiofrequency Ablation for Barrett Esophagus with Low-Grade Dysplasia (LGD)

- There is considerable interobserver variability in the diagnosis of low-grade dysplasia (LGD), and the potential exists for overdiagnosis of LGD by nonexpert pathologists (overdiagnosis is due primarily to the difficulty in distinguishing inflammatory changes from LGD).
- There is evidence in the literature that expert gastrointestinal pathologists will downgrade a substantial portion of biopsies that are initially read as LGD by nonexperts (Curvers et al. [2010]; Kerkhof et al. [2007]). As a result, it is ideal that 2 experts in gastrointestinal pathology agree on the diagnosis to confirm LGD; this may result in greater than 75% of initial diagnoses of LGD being downgraded to nondysplasia (Curvers et al. [2010]). A review by a single expert gastrointestinal pathologist will also result in a large number of LGD diagnoses being downgraded, although probably not as many as achieved using 2 expert pathologists (Kerkhof et al., 2007).

PROCEDURE CODES AND BILLING GUIDELINES

To report provider services, use appropriate CPT* codes, Alpha Numeric (HCPCS level 2) codes, Revenue codes, and/or ICD diagnosis codes.

- 43229 Esophagoscopy, flexible, transoral, diagnostic, including collection of specimen(s) by brushing or washing, when performed; with ablation of tumor(s), polyp(s), or other lesion(s)
- 43270 Esophagogastroduodenoscopy, flexible, transoral; with ablation of tumor(s), polyp(s), or other lesion(s)

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POLICY HISTORY

Date	Reason	Action
October 2022	Annual Review	Policy Revised
October 2021	Annual Review	Policy Revision, New Policy Created

New information or technology that would be relevant for Wellmark to consider when this policy is next reviewed may be submitted to:

Wellmark Blue Cross and Blue Shield
Medical Policy Analyst
PO Box 9232
Des Moines, IA 50306-9232

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