Radiofrequency Ablation of Barrett's Esophagus

Efficacy, Complications, and Durability

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KEYWORDS

• Radiofrequency ablation • Barrett's esophagus • Esophageal adenocarcinoma • Dysplasia • Neoplasia

KEY POINTS

- Radiofrequency ablation in combination with endoscopic mucosal resection effectively induces reconstitution of (neo)squamous epithelium and reduces the risk of disease progression in patients with dysplastic Barrett's esophagus.
- Radiofrequency ablation has an excellent safety profile, although benign stricturing may occur in approximately 6% to 10% of patients and is usually responsive to endoscopic dilation.
- Despite effective radiofrequency ablation, the risk of recurrent intestinal metaplasia or Barrett's-related neoplasia, including invasive adenocarcinoma, is not negligible and necessitates postablation surveillance.

INTRODUCTION

Barrett's esophagus (BE) is defined as a metaplastic change in the normal esophageal squamous epithelium to an intestinalized columnar epithelium, likely in response to chronic acid-related inflammation. BE may progress through increasingly neoplastic stages beginning with nondysplastic BE (NDBE), followed by BE with low-grade dysplasia (LGD), then BE with high-grade dysplasia (HGD), then intramucosal carcinoma (IMC), and ultimately invasive adenocarcinoma. The prognosis for advanced esophageal adenocarcinoma (EAC) remains dismal with a 5-year survival of less than 20%.[1] Therefore, as the only known precursor to EAC, BE has been the longstanding focus of potential therapies that aim to decrease the risk of malignant progression.

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During the last decade, radiofrequency ablation (RFA) has risen to become a first-line option for treating neoplastic BE (LGD, HGD, or IMC following endoscopic resection of nodular lesions). RFA involves applying radiofrequency energy directly to Barrett's epithelium. The high-frequency (typically 350–500 kHz) energy limits the damage to mucosa (and does not involve submucosa or muscularis propria), decreasing the possibility of stricture formation. Energy is delivered circumferentially in the tubular esophagus using a balloon-based 360° catheter that is 3 cm in length, or focally for small/residual areas of intestinalized epithelium using an endoscope-mounted device. More recent technologic advancements include a self-sizing balloon catheter (eliminating the fairly time consuming need for sizing of the esophagus in 1-cm increments) and a through-the-biopsy-channel RFA probe that allows treatment of areas without needing to withdraw the endoscope. Following RFA treatment and appropriate acid suppression, reconstitution of (neo)squamous epithelium can ensue. Typically, two to three RFA treatment sessions are necessary to attain the goal of complete eradication of intestinal metaplasia (CE-IM), as determined by systematic biopsies in the region of initial BE involvement. In some cases, IM may persist after complete eradication of dysplasia (CE-D). Although early studies established the role of RFA in the management of BE, a growing body of literature on long-term outcomes has developed from larger cohorts with longer patient follow-up after treatment. In this article, we provide an updated review of RFA efficacy, complications, and durability.

EFFICACY

Initial Clinical Trials

Initial reports of clinical trials investigating RFA for the treatment of BE appeared in 2007, when Sharma and colleagues[2] reported their findings from a prospective multicenter study titled Ablation of Intestinal Metaplasia (AIM-I) Trial. Seventy patients with NDBE measuring 2 to 6 cm were enrolled for circumferential balloon-based RFA. Initial studies like this were often limited to patients with BE measuring less than 8 cm because of concerns regarding pain control. RFA was applied at an energy density of 10 J/cm^2 (as established during a prior dosimetry phase). A second treatment was applied at 4 months for persistent IM. At 12 months, and after a mean 1.5 treatment sessions per patient, 70% of patients achieved CE-IM, whereas another 25% had persistent, but partial ($\geq$50%) improvement in length of BE.

The investigators hypothesized that treatment efficacy may be enhanced with the incorporation of a forthcoming focal RFA device developed to target anatomically challenging regions, including the flaring gastroesophageal junction in the setting of a hiatal hernia. These devices would also allow treatment of 25% or less of the circumference of the esophagus and up to 3 cm in length with a single application. Subjects were therefore later invited for a follow-up endoscopy and ablation with a focal device if endoscopically or histologically indicated.[3] It should be noted that a higher energy level for focal device was used (and is currently recommended) as compared with the circumferential probe (12 J/cm^2 vs 10 J/cm^2), although the improved efficacy for higher dosimetry has not been conclusively demonstrated. A total of 62 of 70 (89%) participated in the study extension and underwent an additional mean 1.9 treatment sessions focal RFA. At 30 months, CE-IM was achieved in a remarkable 98% of available patients.

Subsequent studies aimed to evaluate the efficacy of RFA in BE with increasing neoplasia, where the opportunity for reducing risk of malignant progression remains greatest. In a prospective multicenter study by Ganz and colleagues,[4] 142 patients with BE and HGD underwent circumferential balloon-based ablation, of which 92