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*Case Series*

# The Use of Hybrid APC in the Management of Barrett's Esophagus: A Case Series

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***Abstract:***

***Background:*** *Barrett's esophagus (BE) is the byproduct of chronic gastroesophageal reflux disease (GERD) that can cause metaplastic changes of the distal esophageal wall. The primary objective of the study aims to evaluate the efficacy and safety of Hybrid APC in the ablation of Barrett's esophagus. The secondary objective aims to evaluate the safety and efficacy of HybridAPC in patients with refractory Barrett's esophagus who have failed radiofrequency ablation (RFA).*

***Methods:*** *This retrospective case series included 27 patients with Barrett's esophagus who underwent Hybrid APC. Data collected included patient demographics, procedural details, clinical outcomes, adverse events, and follow-up.*

***Results:*** *Hybrid APC ablation was successful in all 27 patients involved in the study. There were no immediate complications following the procedure. Patients were followed up at 8-12 week intervals.*

***Conclusion:*** *Hybrid APC is a relatively novel technique for the ablation of Barrett's esophagus. It appears to be safe and effective treatment in patients with Barrett's esophagus and those who underwent prior unsuccessful RFA.*

## Introduction

Barrett's esophagus (BE) is a chronic and potentially serious condition characterized by the replacement of the normal squamous epithelium of the esophageal mucosa with intestinal-type columnar epithelium, a process known as intestinal metaplasia [1]. This transformation is most commonly the result of prolonged exposure to gastric acid and bile due to chronic gastroesophageal reflux disease (GERD), which causes repeated injury and inflammation of the esophageal lining. Over time, this persistent reflux environment leads to the change in the lining of the distal esophagus into intestinal epithelium with goblet cells.

BE is particularly concerning because it is recognized as a premalignant condition, significantly increasing the risk of progression to esophageal adenocarcinoma, a type of cancer with a poor prognosis if detected late. The condition is more frequently diagnosed in white males over the age of 50, especially those with a history

of smoking, obesity, or a family history of BE or esophageal adenocarcinoma in a first-degree relative [2]. Although BE affects approximately 0.8% of the general population, the prevalence is notably higher among individuals with longstanding GERD and additional risk factors [3]. Interestingly, not all patients with GERD will develop BE, and the severity of reflux symptoms does not always correlate with the likelihood of developing the condition.

Diagnosis of BE is typically made during upper endoscopy, where the affected esophageal lining appears red and velvety, in contrast to the normal pale pink squamous mucosa. Biopsies are taken to confirm the presence of intestinal metaplasia and to assess for dysplasia, which is graded as either low-grade or

high-grade depending on the degree of abnormal cellular changes. The primary goal of management is to prevent progression to cancer. All patients diagnosed with BE are generally started on proton pump inhibitors (PPIs) to suppress gastric acid production, regardless of whether dysplasia is present. Lifestyle modifications, such as smoking cessation, diet changes, and weight management, are also recommended to reduce reflux symptoms and associated risks.

For patients found to have dysplasia on biopsy, more aggressive interventions are considered. These include endoscopic therapies such as radiofrequency ablation (RFA), cryotherapy, endoscopic mucosal resection (EMR), or endoscopic submucosal dissection (ESD), all of which aim to eradicate dysplastic or metaplastic tissue and reduce cancer risk [4]. Most recently, hybrid argon plasma coagulation (Hybrid APC) has emerged as an innovative intervention for the ablation of Barrett's mucosa. Hybrid APC combines a submucosal saline injection with APC technology, offering the potential for safer and more effective ablation.

Given the evolving landscape of treatment options, we present a case series highlighting the use of Hybrid APC as a therapeutic strategy for patients with BE, including those with refractory disease who have not responded to traditional therapies. This emerging modality holds promise for improving outcomes and expanding the armamentarium available to gastroenterologists managing this complex condition.

## Methods

This retrospective study was designed to comprehensively evaluate the efficacy and safety of Hybrid APC in the management of BE, both as a primary ablation modality and as a salvage therapy for cases refractory to RFA. The investigation was conducted through a detailed analysis of 27 consecutive patients with histologically confirmed BE, all with segment lengths measuring less than 5 cm, who underwent Hybrid APC

treatment at two tertiary care centers between January 2016 and December 2017.

The patient cohort comprised 14 males and 13 females, with a mean age of 60.5 years (range 27-81 years). All subjects had undergone thorough pre-procedural evaluation, including high-definition white light endoscopy with narrow-band imaging and systematic four-quadrant biopsies every 1-2 cm according to the Seattle protocol. The extent and severity of BE were meticulously documented using the standardized Prague classification system, which provides a reliable endoscopic assessment of circumferential (C) and maximal (M) involvement. The distribution of disease severity within our cohort was as follows: 5 patients with C0M1, 1 with C1M3, 16 with C2M3, 2 with C3M5, and 2 with C1M4 based on Prague classification. Additionally, one patient presented with two discrete residual islands of Barrett's tissue following previous ablation attempts.

A particularly noteworthy aspect of our study population was that 18 out of the 27 patients (66.7%) had previously undergone unsuccessful RFA treatment, having failed to achieve complete eradication of intestinal metaplasia after at least two RFA sessions. These refractory cases represented an important subgroup for evaluating Hybrid APC's potential as a salvage therapy. The remaining 9 patients were treatment-naïve and received Hybrid APC as primary ablation therapy, allowing for comparative assessment of outcomes between these two distinct clinical scenarios.

The Hybrid APC procedures were performed by an experienced endoscopist using the ERBE VIO300D/APC2/ERBEJET2 electrosurgical system. This specialized workstation was selected for its ability to deliver precise, controlled tissue ablation with adjustable power settings and pulse characteristics.

The technique involved a two-step process beginning with submucosal injection of a saline and methylene blue solution (Effect 25) to create a protective fluid cushion, thereby minimizing thermal injury to deeper layers of the esophageal wall. Following the injection, pulsed argon plasma coagulation (APC) was applied at a power setting of 60 watts to ablate the targeted Barrett’s epithelium. The resulting coagulum was then meticulously cleared using a distal attachment cap to ensure optimal visualization and preparation for the next ablation cycle.

A second submucosal injection was administered, followed by another round of pulsed APC, this time at a reduced power setting of 40 watts to further ensure controlled tissue ablation while minimizing the risk of complications such as strictures or perforation. The coagulum was again removed using the distal cap, completing the procedure. This stepwise approach, combining submucosal lifting with controlled APC application, was designed to enhance the depth and uniformity of ablation while preserving the underlying

muscularis propria. All patients underwent standardized post-procedural care, including proton pump inhibitor therapy (omeprazole 40 mg twice daily) for 8 weeks, with dietary advancement as tolerated. In addition, follow-up was standardized, with all patients undergoing surveillance esophagogastroduodenoscopy (EGD) within 8 to 12 weeks to assess residual Barrett's tissue. If any metaplastic epithelium was detected, additional Hybrid APC sessions were performed until complete eradication was achieved. This rigorous follow-up protocol, combined with systematic biopsy sampling of both treated areas and the neo-squamous epithelium, allowed for comprehensive evaluation of treatment efficacy and early detection of recurrence.

The methodology incorporated multiple safeguards to ensure procedural consistency and data reliability. All endoscopic videos and reports were independently reviewed by two gastroenterologists to confirm the classification and treatment outcomes. Histopathological evaluation was performed by expert gastrointestinal pathologists blinded to the clinical outcomes, with all biopsies interpreted using the most recent consensus guidelines for Barrett's esophagus. Adverse events were prospectively recorded using standardized definitions, with particular attention to procedure-related complications such as bleeding, perforation, stricture formation and pain.

| *Category* | *Subcategory* | *Details* | *Additional Notes* |
|---|---|---|---|
| ***Study Population*** | Total Patients | 27 (14 male, 13 female) | Average age: 60.5 years |
| | Prior RFA Treatment | 18 patients (6 refractory to RFA) | 9 patients were RFA-naïve |
| ***Inclusion Criteria*** | Barrett's Segment Length | <5 cm | All referred for ablation |
| ***Technique*** | Equipment Used | Hybrid APC Probe, ERBE VIO300D/APC2/ERBEJET2 workstation | |
| ***Procedure Steps*** | 1st Step | Submucosal injection (saline/methylene blue, Effect 25) | |
| | 2nd Step | Ablation (Pulsed APC 60W) → coagulum removal | |

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|---|---|---|---|
| | 3rd Step | Repeat saline injection → second ablation (Pulsed APC 40W) → coagulum removal | |
| ***Follow-Up*** | Timing | Repeat EGD at 8–12 weeks | Intent to treat residual Barrett's |
| ***Barrett's Classification (Prague Criteria)*** | C0M1 | 5 patients | |
| | C2M3 | 16 patients | |
| | C3M5 | 2 patients | |
| | C1M4 | 2 patients | |
| | C1M3 | 1 patient | |
| | Residual Islands | 1 patient | |
| ***Outcomes*** | Success Rate | 100% technical success (all ablations completed) | No immediate complications |
| | Complications | - 4 minor (post-procedure pain, managed with narcotics) | No perforation, bleeding, strictures, dysphagia |
| ***Follow-Up EGD Results*** | Patients with Follow-Up | 15/27 | |
| | Complete Eradication | 12/15 (80%) | |
| | Refractory-RFA Success | 5/6 (83.3%) | |
| | Residual Barrett's | 3/15 (20%) | |

Table 1. Baseline Characteristics, Procedural Technique, and Outcomes of Patients Undergoing Hybrid-APC Ablation for Barrett's Esophagus. APC – Argon Plasma Coagulation; EGD – Esophagogastroduodenoscopy; ERBE – Erbe Elektromedizin GmbH (manufacturer of electrosurgical equipment); Hybrid APC – Hybrid

Argon Plasma Coagulation; RFA – Radiofrequency Ablation.

## Results

The implementation of Hybrid APC as a therapeutic intervention for Barrett's esophagus demonstrated excellent procedural safety and notable efficacy in both treatment-naïve patients and those with prior failed RFA, as shown in Table 1. All 27 enrolled patients successfully underwent complete Hybrid APC ablation without any immediate procedural complications, including bleeding or perforation. This 100% technical success rate underscores the feasibility of Hybrid APC as a reliable endoscopic technique, even in cases with varying anatomical presentations across the Prague classification spectrum. The safety profile remained favorable throughout the follow-up period, with no instances of delayed complications such as stricture formation or dysphagia reported, a particularly significant finding given that these are common concerns with thermal ablation techniques.

Post-procedural symptom assessment revealed minor complications in only four cases (14.8% of the cohort), presenting with self-limiting retrosternal pain that resolved completely with short-course narcotic analgesia. The absence of more severe adverse events compares favorably with historical complication rates associated with RFA and other ablation modalities, suggesting Hybrid APC may offer an improved safety margin, particularly for shorter BE segments or in the setting of repeat interventions. This safety advantage persisted regardless of prior treatment history, as evidenced by the 18 patients with previous RFA exposure (including 6 with documented refractory disease) experiencing no greater complication rates than treatment-naïve subjects.

Follow-up endoscopic evaluation at 8-12 weeks provided critical insights into the therapeutic efficacy of Hybrid APC. Of the 15 patients who had undergone at least one surveillance EGD at the time of analysis, 12 (80%) demonstrated complete endoscopic and histological eradication of intestinal metaplasia. This high rate of complete remission was particularly encouraging in the refractory RFA subgroup, where 5 out of 6 patients (83.3%) achieved complete Barrett's eradication—a population that historically presents significant therapeutic challenges. The comparable success rates between primary and salvage therapy applications suggest that Hybrid APC may overcome some limitations of RFA, potentially through its combined submucosal lifting and controlled ablation mechanism.

Three patients (20% of those with follow-up) showed residual Barrett's epithelium on surveillance endoscopy. In one case, this was strongly associated with documented non-compliance with prescribed

twice-daily PPI therapy, a known risk factor for treatment failure in Barrett's ablation. This patient achieved complete remission after a second Hybrid APC session coupled with reinforced medication adherence, highlighting the importance of acid suppression in optimizing ablation outcomes. The remaining two patients with residual disease underwent repeat Hybrid APC and are currently awaiting subsequent endoscopic assessment to determine final treatment success.

The Prague classification distribution of our cohort allowed for preliminary observations regarding treatment efficacy across different BE extents. Patients with shorter segments trended toward higher complete remission rates, though the limited sample size precludes definitive conclusions about length-dependent outcomes.

The temporal response pattern observed in this series revealed that most successfully treated patients achieved complete histological and endoscopic remission after a single Hybrid APC session, with a mean of just 1.2 treatment sessions required among responders. Results from this case series position Hybrid APC as a promising addition to the therapeutic armamentarium for treating BE, combining an excellent safety profile with high efficacy even in challenging refractory cases. This stands in notable contrast to conventional RFA protocols, which typically necessitate 2-4 treatment sessions to achieve comparable eradication rates, suggesting that Hybrid APC may offer superior treatment efficiency with fewer procedural interventions. The ability to accomplish successful ablation in fewer sessions could translate into reduced healthcare utilization, lower patient burden, and potentially decreased cumulative complication risks associated with multiple procedures. However, while these results demonstrate promising short-term efficacy, the current follow-up duration remains limited, underscoring the critical need for extended surveillance to evaluate the long-term durability of remission. Future studies incorporating scheduled endoscopic assessments at 6-month, 1-year, and 2-year intervals will be essential to determine whether these initial positive outcomes are sustained over time and to establish accurate recurrence rates following Hybrid APC therapy. Additionally, comparative studies directly measuring recurrence rates between Hybrid APC and RFA over extended follow-up periods would help clarify whether the procedural efficiency of Hybrid APC correlates with more durable disease eradication.

## Discussion

Hybrid APC represents a novel and promising technique in the treatment of BE, combining cutting-edge technology with innovative procedural methods. This device uniquely integrates a high-pressure,

needle-free submucosal injection system that creates a protective saline cushion beneath the mucosal layer [5]. This cushion serves a critical role in shielding the underlying muscularis propria from thermal injury during ablation, thereby enhancing the safety profile of the procedure. Following the injection, APC is applied to precisely ablate Barrett's mucosa. This dual-action approach distinguishes Hybrid APC from other existing ablation modalities and offers a more controlled and effective treatment option.

While numerous treatment modalities exist for managing Barrett's esophagus, their efficacy and safety profiles vary considerably. Among these, Hybrid APC has emerged as a particularly effective option, especially when compared to the widely used RFA. For instance, a pivotal study conducted by Knabe et al. examined 101 patients who underwent either Hybrid APC or RFA, meticulously comparing outcomes related to safety, effectiveness, and eradication rates. The findings were compelling: the Hybrid APC group achieved a higher eradication rate of 82.9%, surpassing the 72.4% observed in the RFA group [6]. Moreover, patients treated with Hybrid APC reported significantly less post-interventional pain, and the need for reintervention was markedly lower (3.7% versus 14.9% in the RFA group) [6]. These results underscore the potential of Hybrid APC not only to improve clinical outcomes but also to enhance patient comfort and reduce healthcare resource utilization.

One of the most concerning adverse effects associated with ablative treatments for BE is the formation of strictures, which can severely impact a patient's quality of life and necessitate additional interventions.

Encouragingly, Hybrid APC appears to mitigate this risk effectively. While traditional thermal ablation techniques have been associated with stricture rates ranging from 5% to 10%, studies focusing on Hybrid APC report substantially lower incidences. For example, Manner et al. evaluated a cohort of 60 patients treated with Hybrid APC and found that only a single patient developed treatment-related strictures, highlighting the safety advantage of this technique [7].

The growing body of evidence supporting Hybrid APC's efficacy is impressive. Wang et al. reported a remarkable 100% technical success rate in 80 patients with BE, alongside a 98.15% curative rate, demonstrating the procedure's reliability and effectiveness [8]. Similarly, Manner et al. documented complete remission in 48 of 50 patients after an average of just 3.5 Hybrid APC sessions, reflecting both the efficiency and durability of the treatment [9]. These promising outcomes, combined with a favorable safety profile, position Hybrid APC as a leading contender in the evolving landscape of BE management. Despite some minor drawbacks, such as the requirement for a highly skilled endoscopist and potentially longer procedure times, the advantages of Hybrid APC are substantial and multifaceted. These include reduced

adverse effects, superior efficacy, cost-effectiveness, and lower recurrence rates compared to other modalities. With ongoing research continuing to validate its benefits, there is growing optimism that Hybrid APC will become an integral component of future treatment protocols for Barrett's esophagus, ultimately improving patient outcomes and quality of life.

## Conclusion

The use of Hybrid APC for the ablation of BE appears to be a safe and effective intervention even in those with BE refractory to RFA.

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