Atrial fibrillation ablation–induced gastroparesis: A case report and literature review

Tauseef Akhtar, MD,* Hugh Calkins, MD, FHRS,* Robert Bulat, MSc, MD, PhD, FRCPC,† Murray M. Pollack, MD,‡ David D. Spragg, MD, FHRS*

*From the *Division of Cardiology, Johns Hopkins University School of Medicine, Baltimore, Maryland, †Division of Gastroenterology, Johns Hopkins University School of Medicine, Baltimore, Maryland, and ‡Division of Critical Care, Children's National Hospital, George Washington University School of Medicine and Health Sciences, Washington, District of Columbia.*

Introduction

Catheter ablation of atrial fibrillation (AF) is the most common type of ablation procedure performed worldwide.[1] Despite the improvements in ablation techniques, collateral damage resulting from injury to the surrounding structures remains an important mechanism of complications. We describe an interesting case of severe gastroparesis secondary to vagus nerve (VN) injury resulting from radiofrequency (RF) AF ablation. We also provide a review of the existing literature with a focus on prevention and treatment.

Case report

A 70-year-old man underwent redo RF ablation for drug-refractory paroxysmal AF at our center. Previously, he underwent cavotricuspid isthmus ablation for atrial flutter 20 years ago and initial RF pulmonary vein isolation (PVI) AF ablation 14 years previously. His prior ablation procedures were not associated with any complications. His body mass index at the time of his redo AF ablation was 22.8 kg/m^2. His AF ablation procedure was performed under general anesthesia following the standard protocol. CartoMerge (Biosense Webster Inc, Diamond Bar, CA) guidance with a preprocedural cardiac computed tomography was used for anatomical mapping. Double transseptal punctures were performed. At baseline, a multielectrode catheter–identified pulmonary vein (PV) potentials in 3 of 4 PVs, except for the right superior PV. Power delivery was limited to 25 watts on the posterior wall and 30–35 watts elsewhere. A temperature probe was positioned in the esophagus. RF energy was stopped if a more than 0.2°C increase in temperature was observed. AF ablation was performed by wide-area circumferential ablation, as shown in Figures 1 and 2. A total of 69 RF applications were used with a total duration of 1058 seconds. No intraprocedural complications were observed, and the patient was discharged.

Two days after the procedure, he presented to an outside hospital emergency department with complaints of epigastric pain associated with nausea and vomiting. In the emergency department, the patient was afebrile, vitals were stable, and he was in normal sinus rhythm. Systemic examination was remarkable for abdominal tenderness. Computed tomography scan of the abdomen revealed thickened gastric fold with distention of the stomach with fluid. He was discharged and was seen in consultation by a gastroenterologist 10 days after ablation at our center. He was complaining of abdominal fullness and had lost 9 lb since the procedure. An esophagogastroduodenoscopy (EGD) was recommended, and oral metoclopramide was initiated. The EGD revealed no evidence of gastric outlet obstruction and esophageal injury. Ablation-induced gastroparesis was suspected, and a gastric emptying study (GES) was obtained 1 month after the ablation procedure. This revealed a significant delay in both the liquid and solid phases of gastric emptying at over 2 hours of imaging. The patient could not complete 4 hours of the study owing to the severe symptoms. The patient was started on a gastroparesis diet (low fat, low fiber), and metoclopramide was continued. Despite these measures, he had a prolonged course of severe gastroparesis lasting for more than 6 months with fluctuating symptoms associated with 30 pounds of weight loss. His metoclopramide was switched with domperidone, and sotalol was replaced with flecainide, given an additive effect on QT prolongation with domperidone. His symptoms gradually stabilized without requiring invasive intervention.

Discussion

This report describes a case of severe gastroparesis resulting following RF catheter ablation of AF. Unique aspects of this report that warrant attention include the marked severity of what is often considered to be a benign complication, and

KEYWORDS Atrial fibrillation ablation; Cryoablation; Gastroparesis; Radiofrequency ablation; Vagus nerve injury
(Heart Rhythm Case Reports 2020;6:249–252)

Address reprint requests and correspondence: Dr David D. Spragg, 600 North Wolfe Street, Baltimore, MD 21287. E-mail address: dspragg1@jhmi.edu.

https://doi.org/10.1016/j.hrcr.2020.01.004

KEY TEACHING POINTS

- Gastroparesis is an important early complication following atrial fibrillation ablation but surprisingly remains underdiagnosed, as most patients are asymptomatic or minimally symptomatic.
- Most of the cases resolve either spontaneously or with conservative management within 6 months after ablation. However, severe gastroparesis with prolonged debility and significant weight loss can rarely occur.
- Gastroparesis has been reported with both radiofrequency (RF) and cryoablation pulmonary vein isolation (PVI), and preventive strategies are poorly defined. More research is needed to determine the relative risk with RF vs cryoablation PVI and the optimal preventive strategy.

the occurrence despite a very conservative approach to posterior left atrial ablation.

Pathophysiology

Gastroparesis is defined as delayed gastric emptying in the absence of structural obstruction. The mechanism of iatrogenic VN injury during AF ablation resulting in gastroparesis remains poorly defined. The most plausible mechanism appears to be collateral damage to periesophageal VN fibers, which comprise the left vagal trunk and course anterior to the esophagus close to the left atrium and PV. These fibers branch off to innervate the gastric antrum and pyloric spinchter. Gastroparesis as a complication has been described with both RF[2–7] and cryoballoon ablation techniques of PVI.[8–13]

Literature review

Gastroparesis resulting from AF ablation was first reported in 2005.[7] A review of the literature identifies 12 reports describing this complication of AF ablation. Table 1 summarizes all the published reports to date, which have focused on gastroparesis post-AF ablation. The largest study was published by Park and colleagues[12] involving 5380 patients undergoing AF ablation by either RF or cryoablation PVI at a single center and reported a 0.2% incidence of gastroparesis diagnosed on GES. However, diagnostic testing was done only in symptomatic patients. In contrast, Lakkireddy and colleagues[5] reported the highest incidence (48%) of gastroparesis post-RF AF ablation in their prospective study by offering the diagnostic testing for gastroparesis in all the study population regardless of the symptoms. Our review of the literature suggests that it may occur with both cryoablation and RF ablation PVI. Other high-energy modalities of ablation, including high-energy focused ultrasound or laser balloon approaches, may be associated with increased VN injury and attendant gastroparesis, although this phenomenon has not been well addressed in the literature. Most cases of gastroparesis following standard RF or cryoballoon AF ablation occur early and have been described as incidental findings in previous studies. These patients usually have a better outcome, with improvement in symptoms with conservative management within 6 months.

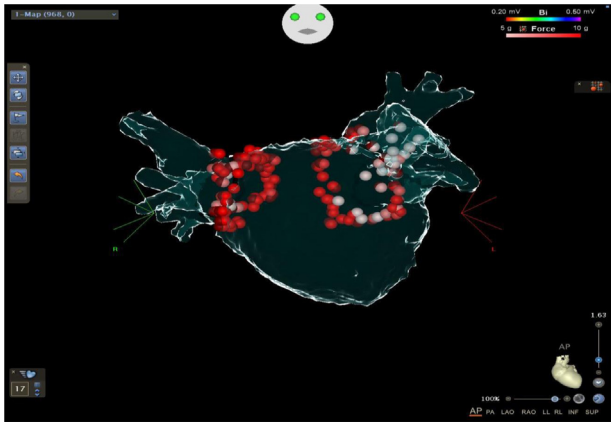

Figure 1 Electroanatomical map of left atrium showing circumferential ablation lesions (cranial view).

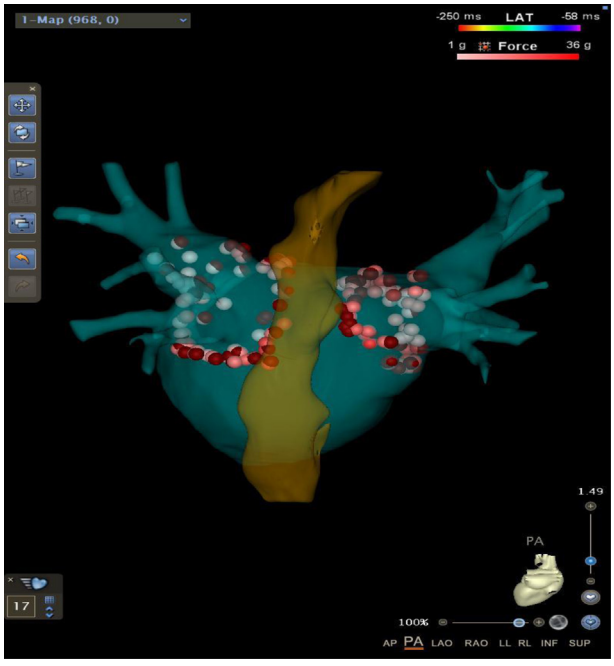

Figure 2 Electroanatomical map of left atrium with esophagus superimposed, showing the ablation lesions in close proximity to lower periesophageal area (posteroanterior [PA] view).

Strategies for prevention

There is no clear consensus on preventive strategies for AF ablation–induced VN damage, as different studies have reported conflicting findings. It is likely that the strategies that have been proposed to prevent atrial esophageal fistula may also help avoid gastroparesis. These include lowering the force and energy application on the posterior wall when RF energy is employed as well as esophageal deviation. The wide variation in the anatomy of VN fibers makes it

Table 1 Summary of published literature on gastroparesis following atrial fibrillation ablation

Study	Number of patients and ablation strategy	Diagnostic modality	Incidence of gastroparesis (%)	Course
Guiot et al[8]	66, first-generation cryoballoon ablation	EGD	9	All the patients were asymptomatic
Lakkireddy et al[5]	27, RF ablation power 30 W on posterior wall and 40 W on anterior wall, energy interrupted if LET >39°C	GES	48	Most of the patients were asymptomatic and gastroparesis resolved in all the patients by 6 months
Aksu et al[10]	58 (cryoablation arm: 240 s for 2 cycles), 46 (RF arm: 20–25 W)	GES in symptomatic patients	10 in cryoballoon ablation arm, 2 in RF arm	Resolved at 6 months in all the patients in cryoablation arm and persisted in RF arm
Kuwahara et al[3]	3695, RF ablation power 25–40 W, energy interrupted if LET >42°C	GES and/or EGD	0.2	72% of the patients fully recovered in 40 days, remaining observed complicated course
Miyazaki et al[9]	140, second-generation cryoballoon ablation, single 3-minute freeze technique	EGD	17.3	All the patients were asymptomatic and gastroparesis resolved at 2 months
Knopp et al[4]	485, RF ablation power 30–50 W, LET was monitored	EGD	17	All the patients were asymptomatic
Park et al[12]	5380, cryoablation or RF	GES	0.2	74% of the patient fully recovered
Pisani et al[6]	1, RF ablation power 25–40 W, LET was monitored	GES and EGD	-	Full recovery within 3 months
Sunata et al[13]	1, cryoballoon	EGD	-	Full recovery within 6 months
Lee et al[11]	1, cryoballoon	GES and EGD		Full recovery within 2 months
Shah et al[7]	4, RF ablation power 35–40 W	GES and EGD	-	Full recovery within 3 months in 2 patients, 2 patients required invasive intervention
Bunch et al[2]	3, RF ablation	CT scan and GES	-	Full recovery in 1 patient

CT = computed tomography; EGD = esophagogastroduodenoscopy; GES = gastric emptying study; LET = luminal esophageal temperature; RF = radiofrequency.

even more susceptible to injury during AF ablation despite the use of preprocedural imaging modalities for anatomical planning. Given the anatomical proximity of the left inferior PV to the esophagus, it is generally believed that gastroparesis occurs during left inferior PV ablation. However, Miyazaki and colleagues[9] reported that the right inferior PV ablation might also predispose to gastroparesis owing to variation in the course of VN fibers. Monitoring of luminal esophageal temperature (LET) and titration of RF energy based on LET has been reported to be protective in the study conducted by Kuwahara and colleagues.[3] In contrast, Lakkireddy and colleagues[5] did not find a correlation between LET and VN damage. Pisani and colleagues[6] also did not report the protective effect of LET monitoring in their case report of gastroparesis. Similarly, our patient also had LET monitoring done. Aksu and colleagues[10] concluded that minimizing the cryoablation in the lower PVs in patients with smaller left atria appears to be protective against gastroparesis.[10] Koruth and colleagues[14] reported that mechanical displacement of the esophagus during ablation could potentially protect esophageal complication along with periesophageal VN injury.[14]

Diagnosis and management

Gastroparesis typically presents with nausea, vomiting, abdominal distension, and early satiety. The diagnosis involves ruling out a mechanical cause of obstruction with barium studies or EGD. These investigations are also helpful in assessing the presence of pyloric spasm and anatomical integrity of esophagus post-ablation. GES is considered to be the gold standard for the diagnosis. Management of gastroparesis is mostly conservative with dietary modification, which includes low-fat meals without indigestible fibers. The use of prokinetic agents (erythromycin, metoclopramide, and domperidone) can be considered to stimulate the gastric contractility. However, the potential risk of torsades de pointes resulting from the additive effect of these drugs with the various antiarrhythmic drugs on QT prolongation should be considered. The use of other agents such as the neuromodulator mirtazapine and the prokinetic prucalopride should be considered. More aggressive and invasive approaches are reserved for nonresponding patients. As with the treatments described above, these have been studied in patients with gastroparesis from causes other than cardiac ablation. Botulinum toxin injection has been used for short-

term relief but has not been proven in randomized controlled trials. Pyloric intervention (surgical pyloromyotomy or gastric per-oral endoscopic myotomy) have improved symptoms and gastric emptying in uncontrolled trials. Gastric electrical stimulation has demonstrated benefit in uncontrolled trials, but less in randomized controlled crossover trials.[15] More aggressive surgical interventions such as subtotal or total gastrectomy have been used in extreme refractory cases but with inconsistent benefit from retrospective data.

Our report is different from the previously published reports in terms of marked severity of the gastroparesis symptoms, with profound weight loss and prolonged course lasting for more than 6 months. Fortunately, our patient recovered without requiring any invasive intervention. This report highlights the observation that gastroparesis, which seems to be a common asymptomatic complication of AF ablation, can also contribute to significant morbidity. A second unique and important aspect of this case is that the complication occurred with a very conservative approach to energy delivery to the posterior left atrium. Power to this region was limited to 25 W in this case, delivered with a force-sensing catheter, and cessation of ablation was performed with 0.2°C rise in esophageal temperature. This highlights that certain patients may be particularly prone to VN injury and that even with conservative approaches, this complication may be encountered.

Conclusion

Gastroparesis is a relatively common complication of AF ablation owing to collateral damage to the periesophageal VN plexus and has been described with both RF and cryoballoon ablation PVI. Most cases are asymptomatic or minimally symptomatic. However, our patient is a sobering reminder that severe gastroparesis leading to weight loss and severe and prolonged disability rarely can occur. The optimal strategies to prevent gastroparesis remain poorly defined. One obvious strategy is abstinence of ablation on top of the esophagus. When this is not feasible, minimizing lesion size by reducing contact force and or power delivery are reasonable options. Another approach is esophageal deviation. More research is needed to define which approach is optimal and to determine the relative risks of this complication with RF vs cryoballoon ablation PVI.

References

1. Calkins H, Hindricks G, Cappato R, et al. HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. Heart Rhythm 2017 2017;14:e275–e444.
2. Bunch TJ, Ellenbogen KA, Packer DL, Asirvatham SJ. Vagus nerve injury after posterior atrial radiofrequency ablation. Heart Rhythm 2008; 5:1327–1330.
3. Kuwahara T, Takahashi A, Takahashi Y, et al. Clinical characteristics and management of periesophageal vagal nerve injury complicating left atrial ablation of atrial fibrillation: lessons from eleven cases. J Cardiovasc Electrophysiol 2013; 24:847–851.
4. Knopp H, Halm U, Lamberts R, et al. Incidental and ablation-induced findings during upper gastrointestinal endoscopy in patients after ablation of atrial fibrillation: a retrospective study of 425 patients. Heart Rhythm 2014;11:574–578.
5. Lakkireddy D, Reddy YM, Atkins D, et al. Effect of atrial fibrillation ablation on gastric motility: the atrial fibrillation gut study. Circ Arrhythm Electrophysiol 2015;8:531–536.
6. Pisani CF, Hachul D, Sosa E, Scanavacca M. Gastric hypomotility following epicardial vagal denervation ablation to treat atrial fibrillation. J Cardiovasc Electrophysiol 2008;19:211–213.
7. Shah D, Dumonceau J-M, Burri H, et al. Acute pyloric spasm and gastric hypomotility: an extracardiac adverse effect of percutaneous radiofrequency ablation for atrial fibrillation. J Am Coll Cardiol 2005;46:327–330.
8. Guiot A, Savouré A, Godin B, Anselme F. Collateral nervous damages after cryoballoon pulmonary vein isolation. J Cardiovasc Electrophysiol 2012; 23:346–351.
9. Miyazaki S, Nakamura H, Taniguchi H, et al. Gastric hypomotility after second-generation cryoballoon ablation—unrecognized silent nerve injury after cryoballoon ablation. Heart Rhythm 2017;14:670–677.
10. Aksu T, Golcuk S, Guler TE, Yalin K, Erden I. Gastroparesis as a complication of atrial fibrillation ablation. Am J Cardiol 2015;116:92–97.
11. Lee DS, Lee SJ. Severe gastroparesis following radiofrequency catheter ablation for atrial fibrillation: suggestion for diagnosis, treatment, and device for gastroparesis after RFCA. Case Rep Gastrointest Med 2014;2014.
12. Park SY, Camilleri M, Packer D, Monahan K. Upper gastrointestinal complications following ablation therapy for atrial fibrillation. Neurogastroenterol Motil 2017;29:e13109.
13. Sunata Y, Mori H, Hirai Y, et al. A case of gastroparesis after cryoballoon ablation followed by medication-induced recovery within 6 months. Case Rep Gastroenterol 2018;12:473–478.
14. Koruth JS, Reddy VY, Miller MA, et al. Mechanical esophageal displacement during catheter ablation for atrial fibrillation. J Cardiovasc Electrophysiol 2012; 23:147–154.
15. Grover M, Farrugia G, Stanghellini V. Gastroparesis: a turning point in understanding and treatment. Gut 2019;68:2238–2250.