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ORIGINAL RESEARCH - PRECLINICAL

Percutaneous LAAO and Pulsed-Field Isolation in a Canine Model

Feasibility and Safety Evaluation

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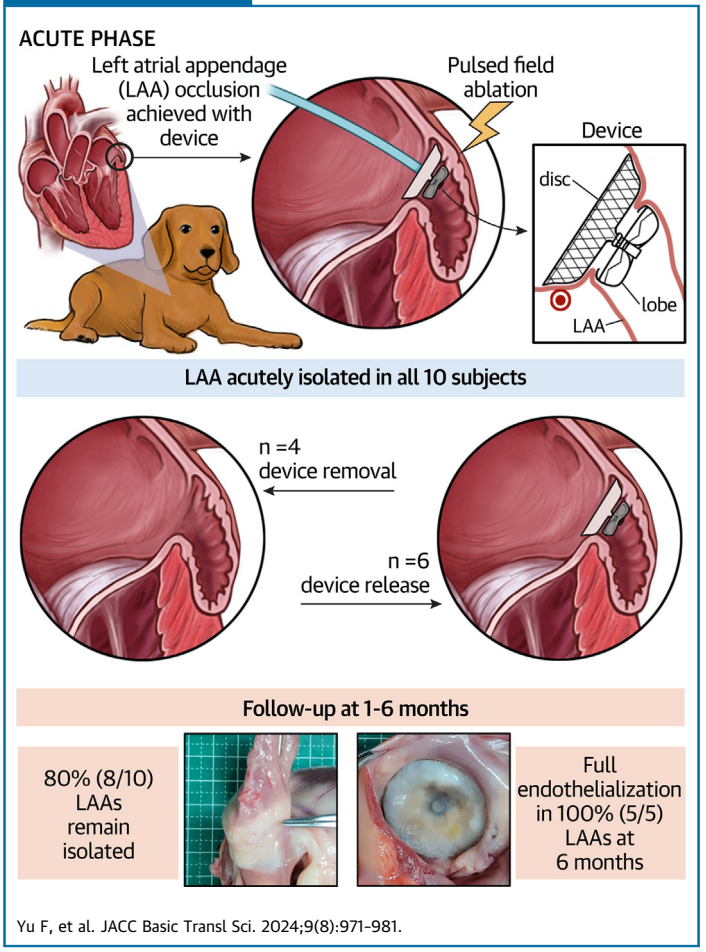
VISUAL ABSTRACT



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HIGHLIGHTS

- **The novel device can safely and effectively occlude and isolate the LAA using PFA.**
- **PFA can generate transmural lesions at the LAA ostium and reserve vessels and nerves.**
- **Full endothelialization was observed at the 6-month follow-up.**

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ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

CS = coronary sinus

ICE = intracardiac echocardiography

LA = left atrium

LAA = left atrial appendage

LAAEI = left atrial appendage electrical isolation

LAAO = left atrial appendage occlusion

LAAp = left atrial appendage potential

LCX = the left circumflex coronary artery

PFA = pulsed field ablation

PFA-LAAEI = left atrial appendage electrical isolation by pulsed field ablation

PI = pulse index

SUMMARY

In this study, we investigated the feasibility, safety, and efficiency of using a novel device system to perform percutaneous left atrial appendage occlusion concomitant with left atrial appendage electrical isolation (LAAEI) via pulsed field ablation. In the acute phase, LAAEI was successful in 10 of 10 canines. At follow-up, full endothelialization was observed in 5 of 5 (100%) cases at 6 months. LAAEI was durable in 8 of 10 (80.00%) canines. Histologic examination in 4 of 6 LAAs with durable isolation showed transmural scars comprising fibrosis and fat. No pericardial effusion or phrenic paralysis was observed at follow-up. This preliminary study provides the scientific basis for first-in-human studies. (JACC Basic Transl Sci 2024;9:971–981) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Left atrial appendage (LAA) electrical isolation (LAAEI) decreases the recurrence of atrial tachycardia and atrial fibrillation (AF) in patients with persistent AF and LAA firing.[1-3] However, there are 2 major concerns about LAAEI. First, LAAEI via conventional thermal energy has unsatisfactory accessibility and safety. LAAEI via radiofrequency ablation is time-consuming and has a steep learning curve. To ensure isolation, prolonged high-power radiofrequency ablation is usually needed,[4] which inevitably increases the risks of perforation and tamponade. On the other hand, cryoablation generally hampers procedures beyond pulmonary vein isolation in persistent AF and increases the risk of injury to adjacent structures, including the left phrenic nerve and the left circumflex (LCX) artery.[5] Second, LAAEI increases the risk of LAA thrombosis and stroke events, resulting in patients requiring either lifelong oral anticoagulation or left atrial appendage occlusion (LAAO).[6] Pulsed field ablation (PFA) uses the nonthermal mechanism of electroporation and creates cardiac lesions in microseconds with a significant amount of tissue specificity, sparing phrenic nerves and the esophagus.[7,8] Concomitant LAAEI by PFA (PFA-LAAEI) and LAAO has not been previously reported; this combination has the potential to conveniently isolate the LAA and eliminate the risk of LAA thrombosis in a single procedure. This study aimed to investigate the feasibility, safety, and efficiency of performing percutaneous LAAO concomitant with PFA-LAAEI using a novel device system.

METHODS

ANIMALS AND PROTOCOLS. Ten healthy Labrador canines were enrolled. All canines underwent PFA-LAAEI. Afterward, devices in the first 4 canines were retrieved to test the feasibility of retrieval, and devices in the other 6 canines were released to evaluate the occlusion outcome during the follow-up period. The study protocol is summarized in Figure 1. This study was approved by the Institutional Animal Care and Use Committee of WestPoint Innovation Center (Chengdu, Sichuan Province, China).

DEVICE DESIGN. The device system includes the E-SeaLA LAA ablation and occlusion device (Hangzhou Dinova EP Technology Co, Ltd) (the device) (Figure 2A), a 3.5-F mapping catheter, a 14-F steerable delivery sheath, a pulsed-field waveform generator, electric transmission catheters (a 10-F outer catheter and a 6-F inner catheter), and cables.

The device has 2 discs consisting of nitinol. The laser-cut anchor disc is self-expanding and equipped with 12 soft hooks to secure the LAA. The sealing disk is made of nitinol mesh, and a membrane that is partially permeable to contrast is sewn inside. A central lumen runs through both discs, reserving access to map the LAA after device deployment (Figure 2B). The device has 11 sizes (the diameters of different anchor discs range between 16 and 36 mm), and it is fully retrievable and repositionable before release.

A pair of electrodes are connected to the inner and outer electric transmission catheter to form a circuit. The outer rim of the sealing disc acts as one electrode,

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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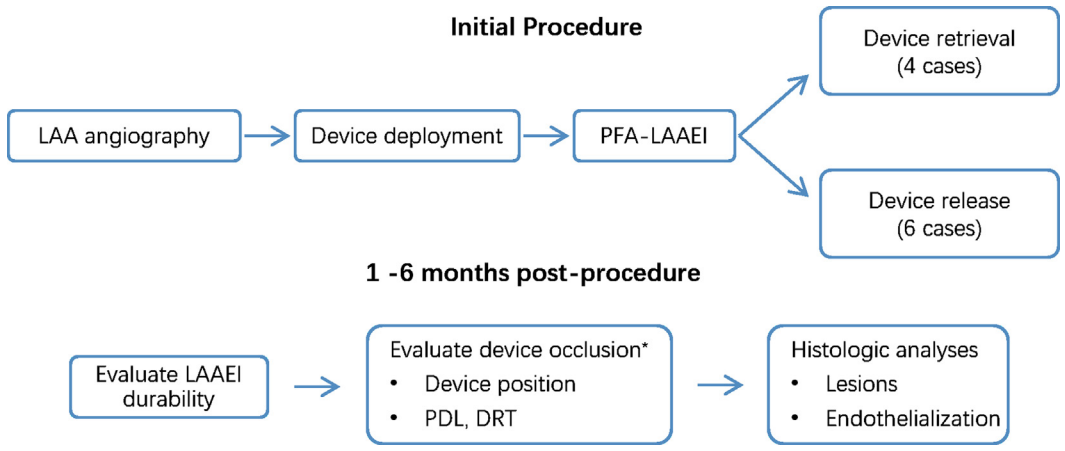
FIGURE 1 Flow Chart of the Study



*Device occlusion was evaluated in the 6 canines with implanted devices. DRT = device-related thrombus; LAA = left atrial appendage; LAAEI = electrical isolation of left atrial appendage; LCX = left circumflex artery; PDL = peridevice leak; PFA-LAAEI = electrical isolation of left atrial appendage by pulsed field ablation.

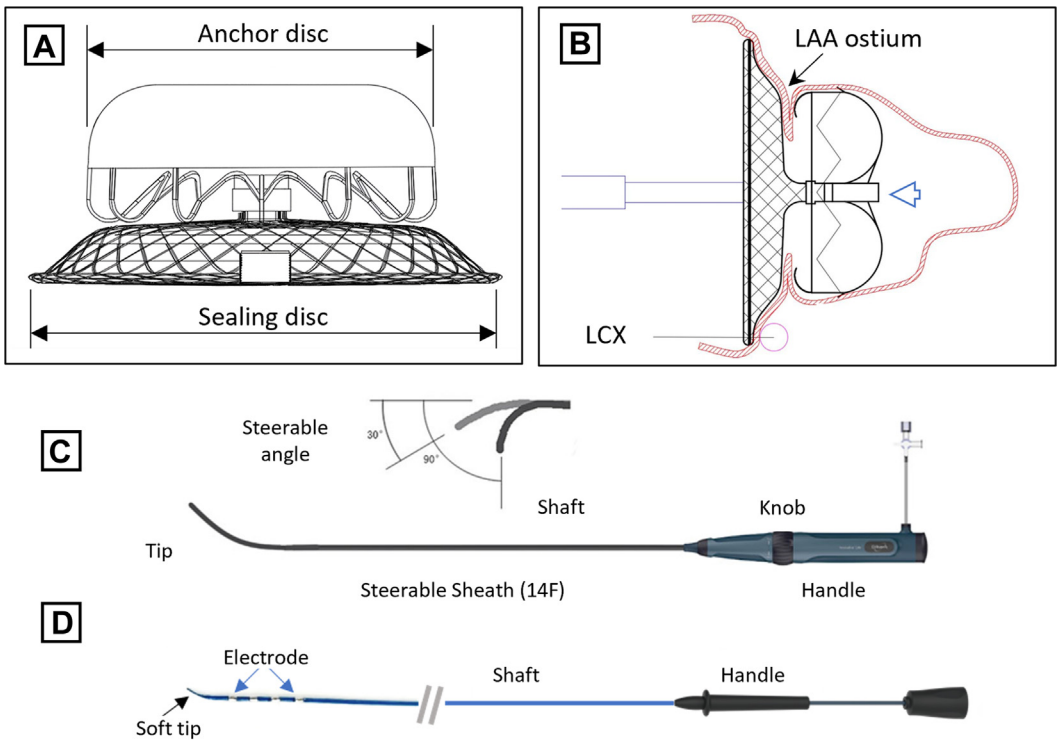
and the other electrode resides in the middle of the anchor disc (Figure 2B). With this electrode configuration, the electric field will form between the 2 discs, and the ablation will concentrate at the LAA ostium clipped in between. In addition, the circuit impedance is constantly monitored. In the case of a sudden impedance surge, delivery would automatically terminate to prevent potential arc formation.

DEVICE DEPLOYMENT. After general anesthesia, vascular accesses were acquired: left femoral arterial access to monitor the blood pressure, bilateral femoral venous accesses to introduce an intracardiac echocardiography (ICE) catheter into the right atrium, a 6-F decapolar catheter (APTMedical) into the coronary sinus (CS), and an 8.5-F SL1 long sheath (St. Jude Medical, Inc) into the left atrium (LA) through transseptal puncture. Heparin was administered to achieve a goal of activated clotting time between 250 s and 300 s. The 14-F steerable delivery sheath was exchanged into the LA, through which a pigtail catheter was introduced for LAA angiography. The diameter and depth of the LAA were measured in the anteroposterior view. At least 2 operators discussed and decided the size of the device. Usually, the chosen anchoring disc was 3 to 6 mm larger than the diameter of the landing zone. Then, the device was connected to the inner and outer electric transmission catheters, introduced to the LAA, and deployed using the same criteria as other lobe-and-disc design occlusion devices. Next, angiography and ICE were used to ensure that there were no residual gaps exceeding 3 mm and no overlap between the sealing disc and the mitral annulus. In the case of an unfavorable position, the device would be retrieved and redeployed for a better position.

LAA ISOLATION BY PFA. PFA was delivered in bipolar and biphasic modes, ungated to the QRS wave, within a voltage range of 1,800 to 2,000 V. From unpublished previous work (personal communication, March 2021), we developed a pulse index (PI) integrating voltage, pulse width, and other parameters, the details of which are intellectual property. Generally, a higher PI value represents a higher electric field intensity. Ablation began with the initial PI for a series of trains (the maximum number of trains was fixed) and then with a higher PI if isolation was not achieved. In the case of unsuccessful isolation, a larger device would be switched to, and energy would be delivered with the initial or a higher PI in sequence, as described. A bonus train was delivered after isolation.

To verify isolation, the mapping catheter was forwarded within the inner electric transmission catheter, was passed through the central lumen, and contacted the LAA endocardium to record LAA potentials (LAAps) (Figure 3A). Acute LAAEI success was defined as LAAp disappearance or dissociation from other atrial potentials, withstanding the isoproterenol or triphosadenine test and a 30-minute waiting period. The bidirectional block between the LA and the LAA was tested by pacing inside the LAA and the CS.

FIGURE 2 Design of the Novel Device System



(A) The novel LAA ablation and occlusion device consists of an anchoring disc covered with a membrane and a sealing disk made of nitinol mesh. (B) One linear electrode is fixed at the anchoring disk, and the other electrode is embedded around the outer rim of the sealing disc. After proper deployment, the ostium of the LAA is usually located between the 2 electrodes. The pink circle at the bottom indicates the LCX. A central lumen (indicated by a blue arrowhead) provides access through the device. (C) A 14-F steerable sheath is used to introduce the device into the left atrium. (D) The 3.5-F quadripolar mapping catheter is designed with a soft tip. The catheter is introduced through the central lumen of the device to record electric potentials from the endocardial LAA. "The device" is short for the novel LAA ablation and occlusion device. Abbreviations as in Figure 1.

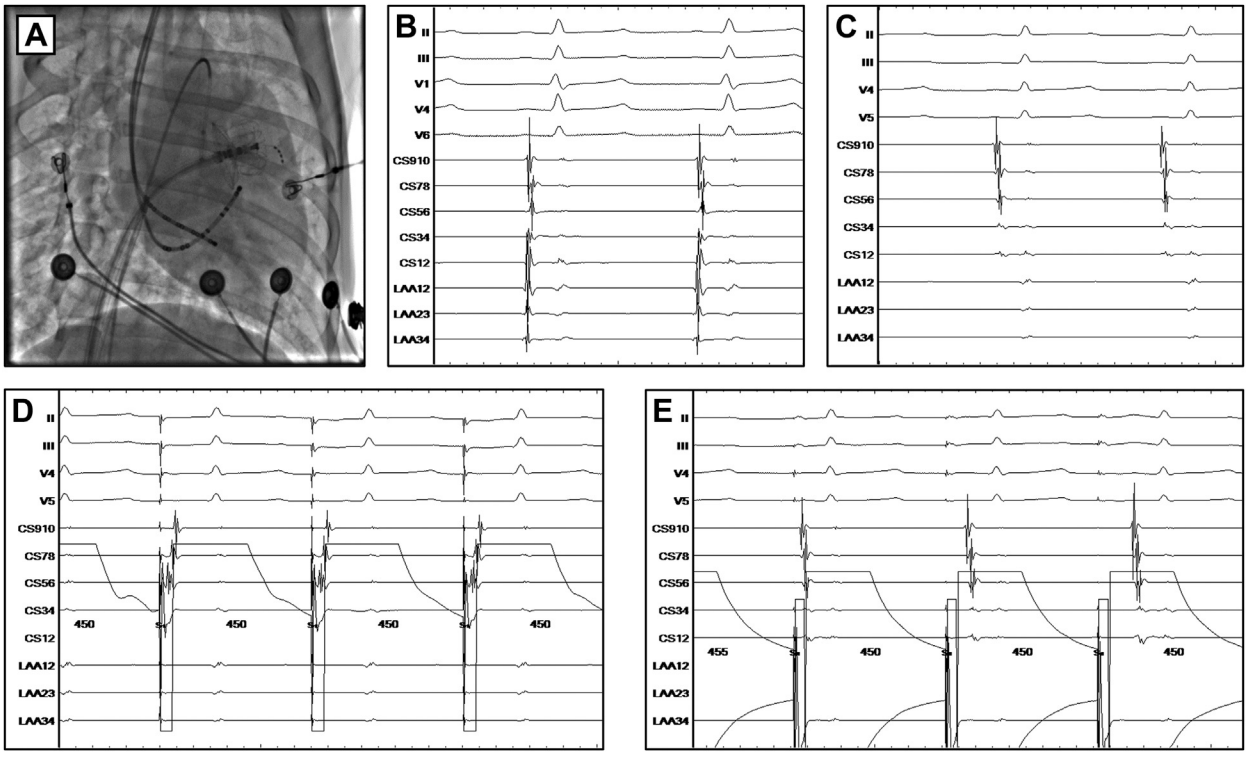
DEVICE RETRIEVAL OR RELEASE. After PFA, devices were retrieved in the first 4 canines and released in the remaining canines after passing the tug test by pulling the outer electric transmission catheter. Afterward, pericardial effusion and the final device position in the last 6 canines were assessed by ICE. Then, all sheaths and catheters were removed, and the canines were awakened.

FOLLOW-UP STUDY. Aspirin (100 mg daily) and clopidogrel (75 mg daily) were administered to each canine. At 1 to 6 months after the initial procedure, the follow-up examination was conducted invasively under general anesthesia. The LAAEI durability, or LAA entrance and exit block, was assessed by pacing in the CS using the decapolar catheter and in the LAA using a Lasso catheter (Biosense Webster, Inc). For the first 4 canines, the Lasso was placed into the LAA. In contrast, for canines with in situ devices, the Lasso was attached to the epicardium of the LAA via a surgical subxiphoid approach (Supplemental Figure 1). Peridevice leaks were evaluated by angiography.

After sacrifice, the heart was explanted, and the LA was opened. The lesion and device (in the last 6 canines) were examined. All LAAs were fixed in formalin. Selected LAAs were cut horizontally or vertically at several planes and stained with hematoxylin and eosin and Masson's trichrome staining. Lesion features, surviving myocardium, and endothelization were studied.

STATISTICAL ANALYSES. Data analyses were performed using SAS version 9.4 (SAS Institute). The normality of the data was checked using the Shapiro-Wilk test. Continuous variables are expressed as the mean ± SD if they conformed to a normal distribution; otherwise, they are expressed as the median with 25th and 75th percentiles (Q1-Q3). Categorical variables are shown as percentages.

FIGURE 3 LAA Electrical Isolation by PFA



(A) The mapping catheter was introduced through the central lumen in the device into the distal part of the LAA. (B) Before ablation, LAAp could be observed on the LAA 12, 23, and 34 channels. (C) Immediately after ablation, the LAAp disappeared. (D) LAA entrance block was confirmed by pacing inside the coronary sinus, which captured the LA and did not conduct to the LAA. (E) LAA exit block was confirmed by pacing inside the LAA, inducing no outward conduction to the LA. LA = left atrium; LAA = left atrial appendage; LAAp = potentials of the LAA; PFA = pulsed field ablation.

RESULTS

ANIMALS AND PROCEDURE. From June 16, 2021, to June 27, 2022, a total of 10 Labrador canines (mean weight: 26.20 ± 1.34 kg) were enrolled. Four (40.00%) of the canines were male. Table 1 summarizes the procedural data and follow-up outcomes.

INITIAL PROCEDURE. The mean LAA ostium diameter was 20.08 ± 2.61 mm, and the final chosen anchoring disc diameter was 24.00 ± 1.26 mm (Table 1). All devices were successfully deployed into the LAAs at favorable positions (without a >3-mm residual gap or overlap with the mitral annulus). All energy delivery was successful and induced no ventricular fibrillation, no hemodynamic change, and no ST-T change. Each train delivery induced 1 abdomen contraction, indicating transient left phrenic nerve capture. In addition, only mild skeletal muscle contraction was identified. All LAAs were successfully isolated: 8 with the initial device and 2 with a larger device (Table 1). After isolation, most LAAps disappeared abruptly (Figure 3). Nevertheless, few dissociated LAAps were sustained within 1 minute before they completely disappeared.

Devices were successfully retrieved from the first 4 canines, and devices in the remaining canines were released to a favorable and stable position. Fluoroscopy did not reveal diaphragmatic hypomobility after any of the procedures.

Pericardial effusion was observed only in canine 7. After the device was released, fluoroscopy revealed mild pericardial effusion (4.8 mm beyond the left ventricular posterior wall), which presumably emerged from the tug test. During a 30-minute observation, the effusions did not increase and the hemodynamics did not deteriorate. Thus, no further management was performed.

FOLLOW-UP STUDY. All animals survived to a follow-up examination at a mean of 4.10 ± 2.13 months (Table 1), and no discernable locomotor abnormalities

TABLE 1 Procedural Data and LAAEI Durability and Endothelialization at Follow-Up

Patient #	Sex	Landing Zone Diameter, mm	Anchoring Disc Diameter, mm	Follow-Up Duration, mo	Occlusion	Full Endothelialization	LAAEI Durability Achieved
1	Male	17.9	20→24	1	No	–	Yes
2	Female	18.5	24	1	No	–	Yes
3	Female	19.3	24	3	No	–	Yes
4	Female	23.3	24	3	No	–	Yes
5	Male	19.0	22	6	Yes	Yes	Yes
6	Male	16.9	22	6	Yes	Yes	No
7	Female	18.4	20→24	3	Yes	No	Yes
8	Female	21.5	26	6	Yes	Yes	Yes
9	Female	20.8	24	6	Yes	Yes	Yes
10	Male	25.2	26	6	Yes	Yes	No

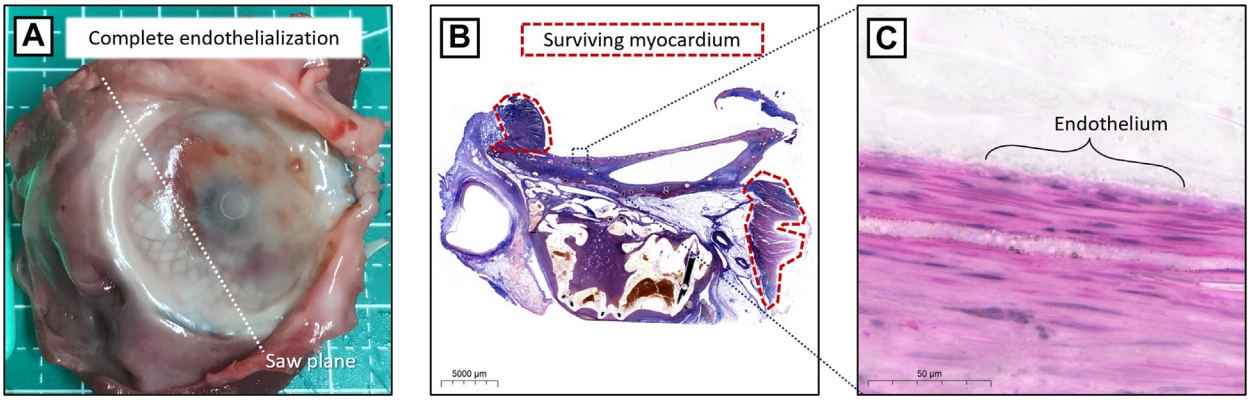
LAAEI = left atrial appendage electrical isolation.

were observed. LAAEI durability was maintained in 8 of 10 (80.00%) canines, and the 2 cases with reconnection were discovered at the 6-month follow-up. Fluoroscopy confirmed that all devices were properly located within the LAA, with no strut fractures or peridevice leaks and with both diaphragms contracted symmetrically.

On gross examination, all sealing discs expanded entirely outside the LAA ostia. There were no peridevice leaks, device-related thrombi, erosions, or ulcers. Connective tissue covered the entire sealing disc in 5 of 5 devices at 6 months (**Figure 4A**). However, the lumen opening was uncovered in the only device followed up at 3 months. In LAAs with durable LAAEI, circular pale lesions were detected between 2 electrodes (**Figure 5A**) and on the epicardial and endocardial side of the LAA ostia. Lesions covered the trabeculations (**Figures 6A, 6B, 7A, and 7B**). However, in reconnected LAAs, viable epicardial cardiac muscles were detected crossing the ablation zone and connecting the LA and LAA (Supplemental Figure 2).

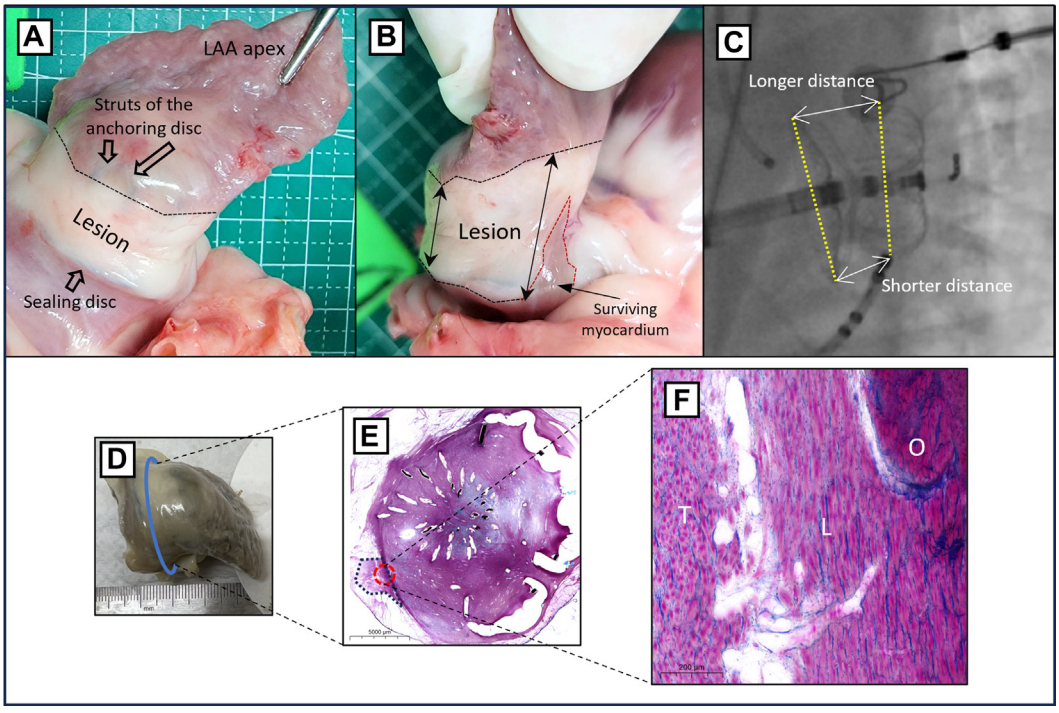
Microscopic pathology was analyzed in 6 LAAs with durable LAAEI. In the ablated zone, the myocardium was replaced by fibrosis or fat (**Figure 6D**) with well-demarcated borders, regardless of whether the follow-up period was 1, 3, or 6 months. Trabeculations at the ostium were also transmurally

FIGURE 4 Gross and Microscopic Examination of the LAA (Canine 7)



(A) Gross examination revealed full endothelialization at the 6-month follow-up. (B) Masson's trichrome–stained section (cut as indicated by the white dotted line in A) showed that the LAA ostium was occluded by the device. Viable myocardium (as indicated by red dashed polygons) outside the device did not connect to the LAA, ensuring durable LAA isolation. (C) Enlarged view (stained with hematoxylin and eosin) of the dashed black square in B showing contact endothelium. LAA = left atrial appendage.

FIGURE 5 Gross and Microscopic Examination of the LAA (Canine 9)



(A) Whitish lesions were located between the anchoring disc and the sealing disc. (B) On the other side, the distance between the 2 discs varied, resulting in a variation in the height of the lesion, as indicated by double-headed arrows. A surviving myocardial bundle was found where the 2 discs stayed away from each other. However, the isolation was durable, since the bundle did not bridge the lesion. (C) Fluoroscopy before energy delivery revealed misalignment of the 2 discs so that the distance between discs was shorter at one end and longer at the other. (D) The LAA was fixed in formalin and cut horizontally (as indicated by the blue circle) for microscopic examination, as shown in E. (E) The tissue was stained with Masson's trichrome. Surviving myocardium was detected in the left lower corner by the edge of the sealing disc, as indicated by the black dashed polygon. (F) Magnification of the red dashed circle in E shows the surviving cardiomyocytes, which are presented in the transverse (T), longitudinal (L), and oblique (O) directions. LAA = left atrial appendage.

ablated (Figure 7E). In addition, viable vessels and nerves were detected within the scar. The median depth of the lesion was 1.40 mm (Q1-Q3: 0.97-2.28 mm), with a range of 0.27 to 2.96 mm. Lesions on slices were transmural in 4 cases (Figures 6 and 7). However, isolated surviving cardiomyocytes were present in the other 2 cases.

In the first case (canine 3), circular lesions were detected at the LAA ostium, with surviving but nonconnected cardiac muscle anterior to the aorta (Supplemental Figure 3A), matching the isolated cardiomyocytes that did not appear on the adjacent slice plane (Supplemental Figures 3B and 3C). In the second case (canine 9), although an intact circular lesion surrounded the LAA ostium near the anchoring disc (Figure 5B), a surviving muscle bundle was found near the sealing disc, matching the isolated cardiomyocytes by the rim of the sealing disc in microscopic examination (Figures 5D to 5F).

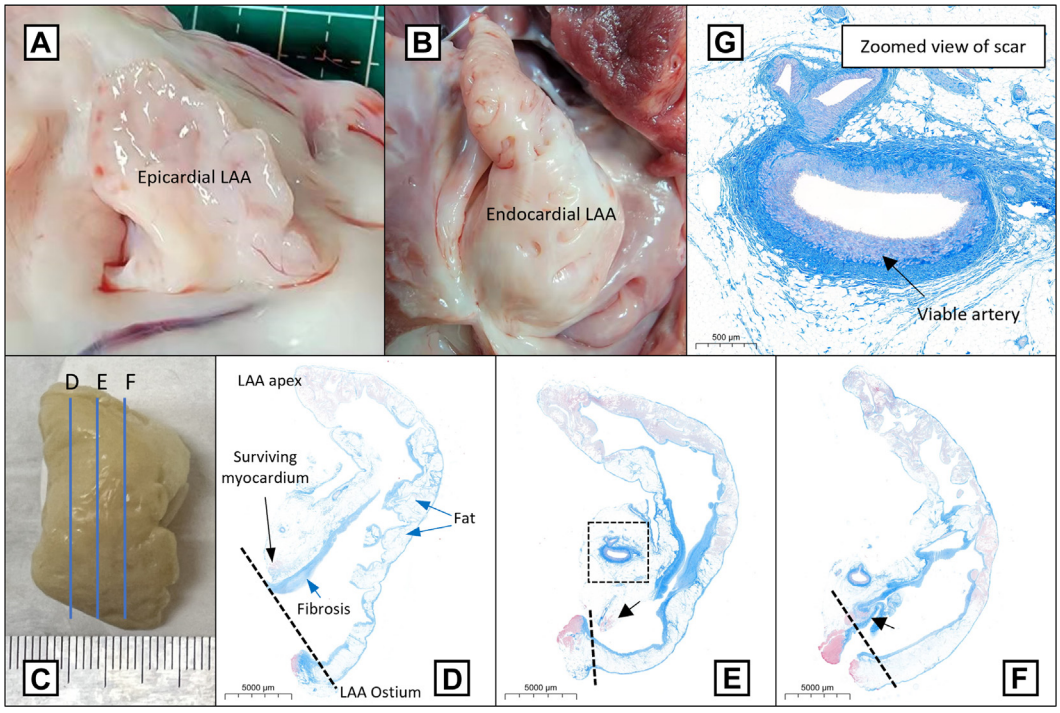
Endothelium and neointima were detected microscopically (Figure 4C), where connective tissue covered the sealing disc.

DISCUSSION

This preliminary study is the first, to our knowledge, to demonstrate that it is feasible, safe, and effective to combine LAAO and PFA-LAAEI in one procedure with this novel device system. The deployment, energy delivery, and release/retrieval operated well without life-threatening complications. LAAEI was achieved in all cases in the initial procedure. In addition, LAAEI durability was maintained in 8 of 10 (80%) canines, and complete endothelialization was achieved after 6 months without peridevice leaks or device-related thrombi.

The study proved that PFA can isolate the LAA. When the pulsed field was first diverted to ablate the

FIGURE 6 Gross and Microscopic Examination of the LAA (Canine 4)



(A, B) Pale lesions were observed at the epicardial and endocardial LAA, encircling the ostium. (C) The LAA was fixed in formalin and vertically cut into 3 slices for microscopic examination, as indicated with blue lines. (D to F) Microscopic views with Masson's trichrome staining corresponding to the 3 vertical sections in C. Black dashed lines indicate the LAA ostium. Surviving myocardium is indicated by black arrows. Blue-stained transmural lesions consisting of fibrosis and fat were located at the ostium, ensuring durable LAA isolation. (G) Zoomed-in view of the dashed black square in E shows viable arteries. LAA = left atrial appendage.

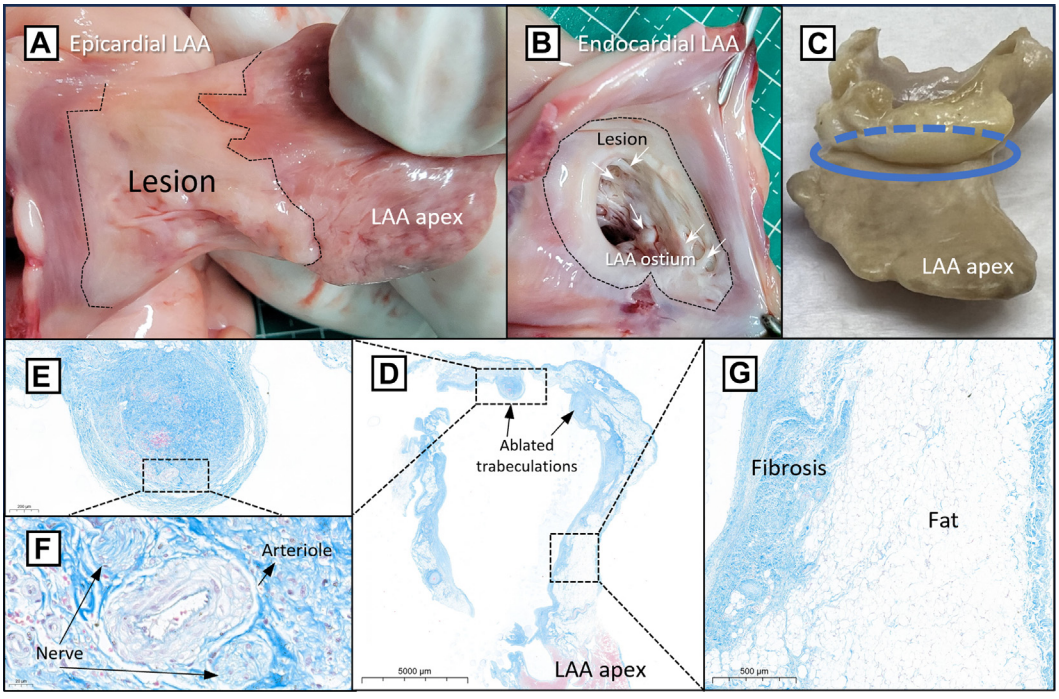
myocardium, Lavee et al[9] succeeded in creating transmural lesions on the LAA using a bipolar clamp. Stewart et al[10] recently achieved transmural lesions on the LAA using a circular catheter. Nevertheless, because both studies aimed to prove the feasibility of transmurally ablating atrial myocardium using the pulsed field, ablation was only administered focally, and the LAAs were not isolated. To our knowledge, our study is the first to validate PFA-LAAEI.

Regarding device design, the 2 electrodes are located separately on the anchor and sealing disc, which embraces several potential advantages. First, the device combines the functions of LAA electric isolation and occlusion. Second, the electric field is concentrated between both discs, contributing to the generation of continuous lesions at the LAA ostium. Unlike some pentaspline or circular PFA catheters for pulmonary vein isolation, our design does not necessitate catheter rotations before further energy deliveries, which not only facilitates the usual occlusion procedure but also demonstrates efficiency with the single-shot style. Third, thanks to the 2 discs clipping the LAA ostium, electrodes on the discs will adhere to the ostium as closely as possible wherever the LAA moves in the atrial cycle, thus leading to a better ablation outcome. Last but not least, all LAAEI occurs at the level of the LAA ostium, thereby facilitating the evaluation of LAAEI's electrophysiologic effect in the future.

In this preliminary study, we found several factors influencing the isolation effect. The PFA parameter is foremost. Although a larger voltage or more repetitions lead to deeper lesions, we restrained the voltage range within 1,800 to 2,000 V and a fixed maximum number of trains per delivery. Most LAAs were successfully isolated using the initial or higher PI within this limit. Excessive voltage or repetitions might increase the temperature at the electrode-tissue interface and create nonspecific injuries, might increase microbubble formation, and might be liable to induce ventricular fibrillation because the device is deployed near the mitral annulus.

Moreover, recent PFA studies indicated that electrode-tissue contact affects lesion depth.[11,12]

FIGURE 7 Gross and Microscopic Examination of the LAA (Canine 2)



(A, B) Circular pale lesions were detected at the epicardial and endocardial LAA ostium, covering the trabeculations as indicated by white arrows. (C) The LAA was fixed in formalin and cut horizontally as indicated by the blue circle for microscopic examination, as shown in D. (D) The tissue was stained with Masson's trichrome. A circular transmural lesion stained blue was observed. (E) Enlarged view of the black dashed rectangle in D reveals that trabeculation was transmurally ablated. (F) Magnified view of the dashed rectangle in E displaying viable nerves and arterioles. (G) Zoomed-in view of the black dashed square in D reveals that the lesion consisted of fibrosis and fat. LAA = left atrial appendage.

We did not find a direct measurement of the electrode-ostium contact in this study. The residual gaps evaluated from fluoroscopy might be used as an indirect measurement to imply partial suboptimal contact between the sealing disc and the LAA ostium. However, devices in 2 cases without obvious residual gaps failed to isolate the LAAs. Isolation was finally achieved after switching to larger devices, indicating that the smaller devices might have unsatisfactory electrode-tissue contact, and the contact was essential in successful PFA-LAAEI. Although larger devices might have better contact, they tend to cause complications, such as the pericardial effusion that appeared after the tug test with the larger device in canine 7. Future studies should investigate the relationship between contact and isolation and determine the optimal device size for isolation and safety.

Furthermore, the angle between the 2 discs after deployment might affect lesion depth. A gross examination of canine 9 showed that the 2 discs/electrodes were not parallel, and a viable muscle bundle was present where the distance between the 2 electrodes was large (Figures 5B and 5C). Theoretically, an excessive angle between 2 discs/electrodes would result in an uneven electric field. The part with a longer distance would have a weaker electric field and a diminished lesion. Few studies have examined the angle between the lobe and disc in LAAO. Cochet et al[13] reported that larger angles were related to peridevice leaks. The excessive angle between 2 discs should be explored further to increase the isolation rate.

Two LAAs failed to demonstrate durable isolation. There are potential reasons for these findings. In the gross examination of canine 6, multiple viable myocardial bundles were present connecting the LA and LAA. In this case, we did not conduct a microscopic examination or measure the lesion depth. Thus, we did not know if the viable bundles were overly thick or if the overall lesion depth was shallow. For canine 10, the gross examination revealed that the lesion covered only the endocardium and did not

penetrate the epicardium. Most of the epicardium was viable for conduction. Because of limitations in the device preparation at that time, a 26-mm device was chosen, although the LAA ostium diameter was measured to be 25.2 mm. We inferred that the contact was poor, leading to reversible ablation to the epicardial side.

Recently, an increasing number of studies have shown that PFA can induce coronary spasm.[14-16] The LCX ran past the epicardial aspect of the LAA base.[17] The artery was usually located between 2 discs after device deployment (**Figure 2B**) and stayed within the electric field. Although there was no hemodynamic change or ST-segment deviations during and after ablation, coronary spasms might be present, at least transiently. Unfortunately, we did not conduct coronary angiography in this study. PFA-induced coronary spasms should cause attention and alarm. The clinical consequences are not always benign. Ventricular fibrillation has been reported.[18] Excitingly, nitroglycerin has been confirmed to attenuate PFA-induced coronary spasm.[19] We are investigating coronary spasms in PFA-LAAEI and the potential benefit of nitroglycerin.

Regarding occlusion, full endothelialization was achieved in all devices followed up at 6 months. There were no erosions surrounding the sealing disc, peridevice leaks, or device-related thrombi. There was concern that LAA ablation would impair the endothelialization of concomitant LAAO. Later, it was confirmed that endothelialization was complete, and no occluder displacement or mechanical erosion in the LAA occurred after concomitant LAAEI by radiofrequency.[20] We have demonstrated that concomitant PFA-LAAEI and LAAO do not cause these adverse events. In the following human studies, the antithrombotic regimen should be determined in reference to the 6 months required to fulfill endothelialization.

The device system demonstrated overall safety during the periprocedural period. However, pericardial effusion occurred in 1 canine after the tug test. It was probably difficult to differentiate between bleeding caused by the tug test and bleeding caused by the device. Although the effusion disappeared in the follow-up, further monitoring and observation are needed in future cases.

STUDY LIMITATIONS. Because of the exploratory nature of this study, the sample size was small, and the follow-up duration was only up to 6 months. More cases and longer follow-up are needed to evaluate LAAEI durability, residual leaks, and impact on coronary arteries in the long term. The dual antiplatelet regimen differed from the anticoagulants that are commonly used after atrial fibrillation ablation, and the antithrombotic regimen needs further investigation. In addition, further research in humans is necessary.

OUTLOOK. This novel device system is promising to simultaneously electrically isolate and occlude the LAA in a convenient manner. Future studies in humans are warranted. It is also necessary to clarify which proportion of patients with persistent AF will benefit from LAAEI.

CONCLUSIONS

In this canine model, it was feasible, safe, and effective to concomitantly occlude and isolate the LAA using PFA with a novel device. This preliminary study provides a scientific basis for first-in-human studies.

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PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: PFA is capable of electrically isolating the LAA. Simultaneous PFA-LAAEI and LAA occlusion is feasible.

TRANSLATIONAL OUTLOOK: This novel device provides a potential interventional treatment for arrhythmia originating in the LAA. Future studies are warranted.

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KEY WORDS atrial fibrillation, left atrial appendage electrical isolation, left atrial appendage occlusion, lesion durability, pulsed field ablation

APPENDIX For supplemental figures, please see the online version of this paper.