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LETTERS

RESEARCH LETTER

# A Pulsed Field Ablation–Based Endocardial Strategy for Ventricular Tachycardia in Arrhythmogenic Right Ventricular Cardiomyopathy

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Catheter ablation for ventricular tachycardia (VT) in arrhythmogenic right ventricular cardiomyopathy (ARVC) can be technically challenging due to thin right ventricular myocardium and frequent epicardial substrate involvement, often necessitating epicardial access.[1] Pulsed field ablation (PFA) induces irreversible electroporation with relative tissue selectivity, preferentially affecting myocardium while sparing adjacent structures.[2] Data on PFA for VT in ARVC remain limited.[3-5]

We present the first consecutive series of a PFA-based endocardial strategy for VT in patients with ARVC. Four consecutive patients meeting 2010 Task Force Criteria for definite ARVC with sustained VT underwent focal ablation using a lattice-tip catheter (Affera Sphere-9; Medtronic) at 2 academic centers. The study database received institutional review board approval, and all patients provided informed consent.

Procedures were performed with the patient under general anesthesia using high-density electroanatomical mapping (Prism; Medtronic). No epicardial access was performed. PFA and radiofrequency (RF) ablation parameters are detailed in **Table 1**. Postablation VT inducibility was assessed by programmed ventricular stimulation using operator-selected protocols, with variation in pacing sites, drive cycle lengths, extrastimuli, and use of isoproterenol based on clinical context. The primary endpoint was acute VT noninducibility. Safety was monitored with continuous hemodynamics and intracardiac echocardiography. PFA was delivered over 4 seconds using 12 trains of 125 biphasic pulses (350-millisecond intertrain delay), with 4 applications per site. RF ablation was performed by using temperature-controlled settings, targeting 73 °C for 5 seconds at 80% current. VT recurrence was defined as any sustained or implantable cardioverter-defibrillator-treated VT, including antitachycardia pacing (ATP)-terminated episodes.

Baseline characteristics, procedural details, and outcomes are summarized in **Table 1**. All patients were male (median age 30.5 years; range 18-72 years). Three patients had pathogenic or likely pathogenic PKP2 variants. Median right ventricular ejection fraction was 21.5% (16%-36%). Two patients had undergone prior unsuccessful RF ablation attempts, including one (Patient 2) who had failed epicardial access due to dense pericardial adhesions (**Figure 1**) and was therefore treated using this PFA-based endocardial approach.

Median procedure time was 212 minutes (Q1-Q3: 142-292 minutes) with fluoroscopy time of 7.9 minutes (Q1-Q3: 3.3-17.4 minutes). A median of 127 PFA

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**TABLE 1 Summary of Baseline, Procedural, and Follow-up Data**

| | Patient 1 | Patient 2 | Patient 3 | Patient 4 |
|---|---|---|---|---|
| Age, yrs | 24 | 72 | 18 | 37 |
| Sex | Male | Male | Male | Male |
| Genotype/pathogenic variant | PKP2 | Genotype screen negative | PKP2 | PKP2 |
| RVEF, % | 23 | 16 | 36 | 20 |
| LVEF, % | 50 | 45 | 47 | 55 |
| ARVC Task Force score | 3 Major, 1 minor | 3 Major, 1 minor | 4 Major | 3 Major, 1 minor |
| Prior RFAs, n | None | 1 Endocardial, 1 failed epicardial due to adhesions | 1 Endocardial, 1 epicardial | None |
| Clinical VT morphology | CL 365 ms, LB, superior axis, V4 transition | CL 421 ms, LB, inferior axis, V3 transition | CL 410 ms, LB, superior axis, V5 transition | CL 400 ms, LB, superior axis, negative concord |
| Procedure time, min | 292 | 214 | 210 | 142 |
| Fluoroscopy time, min | 17.4 | 6.2 | 3.3 | 9.5 |
| PFA applications, n | 134 | 120 | 140 | 49 |
| RFA applications, n | 3 | 0 | 0 | 22 |
| Acute VT noninducibility | Yes | Yes | Yes | Yes |
| VT recurrence | Yes at 151 days, ATP-failed, spontaneous termination | Yes at 94 days, 4 ATP-terminated VT episodes | No | No |
| Follow-up, days | 161 | 251 | HTx at 53 days | 97 days |
| Treated VT episodes preablation (2 yrs) | 3 | 21 | 25 | 9 |
| Treated VT episodes postablation | 1 | 4 | 0 | 0 |
| AADs preablation | Amiodarone, metoprolol | Amiodarone, mexiletine, metoprolol | Amiodarone, lidocaine, flecainide esmolol | Amiodarone, lidocaine, metoprolol |
| AADs postablation | Metoprolol | Amiodarone, metoprolol | None | Metoprolol |

AADs = antiarrhythmic drugs; ARVC = arrhythmogenic right ventricular cardiomyopathy; ATP = antitachycardia pacing; CL = cycle length; HTx = heart transplantation; LB = left bundle; LVEF = left ventricular ejection fraction; PFA = pulsed field ablation; RFA = radiofrequency ablation; RVEF = right ventricular ejection fraction; VT = ventricular tachycardia.

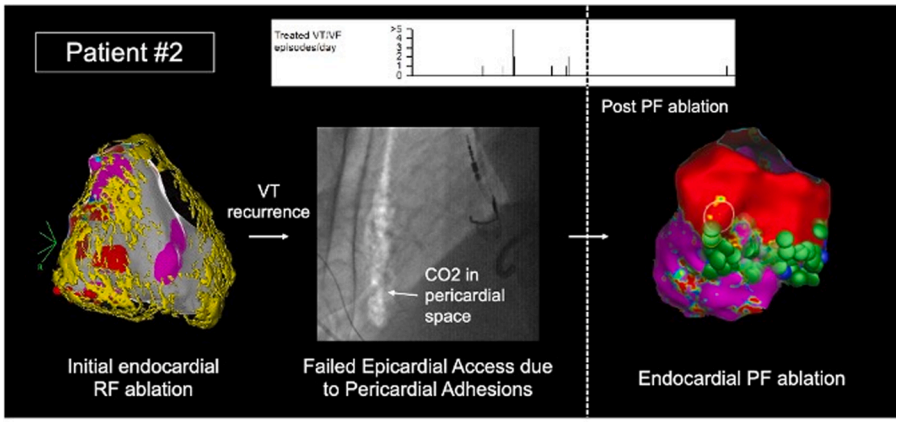
applications (Q1-Q3: 49-140 PFA applications) were delivered per patient. Two patients received limited adjunctive RF ablation (Patient 1: 3 lesions; Patient 4: stacked PFA on RF lesions to enhance lesion depth). Acute VT noninducibility was achieved in all patients (100%). VT terminated during PFA application in 2 cases. Patient 3 presented in refractory VT storm despite intravenous antiarrhythmic infusions, prior surgical sympathectomy, and unsuccessful endocardial RF ablation; VT terminated during PFA, and the patient was noninducible postprocedure. No acute complications occurred. There were no steam pops, cardiac perforation, coronary injury, phrenic nerve palsy, or hemodynamically significant pericardial effusion.

At a median 129 days (Q1-Q3: 53-251 days) of follow-up, 2 patients (50%) experienced VT recurrence. Patient 2 had 4 ATP-terminated VT episodes at 94 days' postablation, and Patient 1 had sustained VT at 151 days that spontaneously terminated after a failed ATP burst. The remaining 2 patients were free from VT through their follow-up periods (97 days and through heart transplantation at 53 days, respectively). Patient 3 underwent heart transplantation 53 days' postablation for progressive heart failure. Histopathologic examination of the explanted heart confirmed fibrofatty myocardial replacement consistent with ARVC; specimens were processed before ablation lesion depth could be assessed.

These findings show that endocardial PFA is feasible and acutely effective for ARVC-related VT with an acceptable acute safety profile. PFA's nonthermal, tissue-selective mechanism may mitigate these risks while potentially enabling deeper endocardial lesion formation. Postprocedure creatinine values were available and did not indicate acute kidney injury; systematic hemolysis assessment was not performed. No acute changes in implantable cardioverter-defibrillator sensing or pacing thresholds were observed after the procedure.

Although the small sample size precludes statistical analysis, the outcomes are consistent with prior

**FIGURE 1** **PF Ablation-Based Endocardial Strategy in Arrhythmogenic Right Ventricular Cardiomyopathy**




**Summary of Baseline, Procedural, and Follow-up Data**

| Characteristic | Patient 1 | Patient 2 | Patient 3 | Patient 4 |
|---|---|---|---|---|
| Age (yrs) | 24 | 72 | 18 | 37 |
| Sex | Male | Male | Male | Male |
| Genotype / Pathogenic Variant | PKP2 | Genotype screen negative | PKP2 | PKP2 |
| RVEF (%) | 23 | 16 | 36 | 20 |
| LVEF (%) | 50 | 45 | 47 | 55 |
| ARVC Task Force Score | 3 Major 1 Minor | 3 Major 1 Minor | 4 Major | |
| Prior RF Ablations (n) | None | 1 Endocardial, 1 failed epicardial due to adhesions | 1 Endocardial 1 Epicardial | None |
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| Procedure Time (min) | 292 | 214 | 210 | 142 |
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| PFA Applications (n) | 134 | 120 | 140 | 49 |
| RFA Applications (n) | 3 | 0 | 0 | 22 |
| Acute VT Non-Inducibility (Y/N) | Yes | Yes | Yes | Yes |
| VT Recurrence | Yes at 151 days, ATP-failed, spontaneous termination | Yes at 94 days, 4 ATP-terminated VT episodes | No | No |
| Follow-up (days) | 161 | 251 | HTx at 53 days | 97 days |
| Treated VT episodes pre ablation (2 yrs) | 3 | 21 | 25 | 9 |
| Treated VT episodes post ablation | 1 | 4 | 0 | 0 |
| AADs pre-ablation | Amiodarone, Metoprolol | Amiodarone, Mexilitine, Metoprolol | Amiodarone, Lidocaine, Flecainide Esmolol | Amiodarone, Lidocaine, Metoprolol |
| AADs post-abaltion | Metoprolol | Amiodarone, Metoprolol | None | Metoprolol |

Abbreviations: ARVC = arrhythmogenic right ventricular cardiomyopathy; CL = cycle length; HTx = heart transplantation; LB = left bundle; PFA = pulsed field ablation; RF = radiofrequency; RVEF = right ventricular ejection fraction; VT = ventricular tachycardia.

CO2 = carbon dioxide; PF = pulsed field; RF = radiofrequency; VF = ventricular fibrillation; VT = ventricular tachycardia.

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ARVC ablation studies reporting 60% to 70% VT-free survival after a single procedure, with many series requiring epicardial access in 25% to 75% of cases.[4,5] In our series, all 4 patients were successfully treated with the PFA-based endocardial approach, avoiding epicardial instrumentation and its associated risks. Notably, VT recurrence in 2 of 4 patients highlights that a PFA-based endocardial strategy may not obviate the need for epicardial ablation in patients with ARVC and significant epicardial substrate.

The successful acute termination of incessant VT in Patient 3, after multiple failed interventions (including RF ablation and surgical sympathectomy), is particularly noteworthy and suggests that PFA may be effective even in highly refractory cases. The 50% freedom from VT recurrence during early follow-up is noteworthy, although the small sample size limits interpretation and longer follow-up is needed to assess lesion durability.

Several limitations warrant acknowledgment. The small sample size and short follow-up duration limit generalizability. Optimal PFA parameters for ventricular substrate remain undefined and were selected based on operator experience. Longer follow-up is needed to assess lesion durability, as VT recurrence in ARVC often manifests over 12 to 24 months.

In conclusion, this early experience suggests that a PFA-based endocardial strategy for VT in ARVC is feasible with an encouraging acute safety profile. Larger studies with longer follow-up are needed to define durability, optimal energy delivery, and the impact on epicardial ablation requirements.

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**KEY WORDS** arrhythmogenic right ventricular cardiomyopathy, pulsed field ablation, ventricular tachycardia ablation