Very high-power short-duration radiofrequency ablation: Identifying its place in the electrophysiologist's armamentarium

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Achieving transmural and durable pulmonary vein isolation (PVI) is the central mission of atrial fibrillation (AF) catheter ablation. As electrophysiologists, we hope to achieve this goal safely, consistently, efficiently, and cost-effectively. With three ablation modalities at our disposal — radiofrequency (RF), cryoablation, and pulsed field ablation (PFA) — and with multiple catheter designs to choose from within each class, one is certainly spoilt for choice. Accordingly, for a novel catheter to establish its place within this crowded market, it must differentiate itself sufficiently from others, offering one or more advantages over its competitors.

Very high-power short-duration (VHPSD) ablation is a recent development in RF technology, allowing delivery of 90 W of power for just 3–4 seconds [1], rather than applications at lower power for longer durations guided by contact force, ablation index (AI) [2], or local impedance [3]. Theoretically, by reducing ablation duration, procedural times should be shortened. Furthermore, by producing larger and shallower lesions than standard-power RF [4], VHPSD seems ideally suited in the thinned-walled left atrium, potentially reducing collateral damage to the esophagus and phrenic nerve. However, as is often the case in medicine, logical assumptions do not always translate into genuine clinical benefit. The question therefore remains: over five years into its journey, where does VHPSD fit within the electrophysiologist's armamentarium? In the current issue of *Pol Heart J*, Peller et al. [5] provide further insights on this topic.

FIRST-PASS PVI WITH VHPSD

Peller et al. [5] report their single-center experience of VHPSD, focusing on first-pass PVI rates compared with standard-power, AI-guided ablation. First-pass isolation (FPI) — defined as electrical isolation of the pulmonary veins upon or before completion of the wide area circumferential ablation lesion set — is associated with fewer long-term PV reconnections and lower arrhythmia recurrence [6]; as such, it is an important intraprocedural surrogate of success.

In their retrospective analysis of 105 patients undergoing first-time PVI (54 VHPSD; 51 AI-guided), the authors observed a bilateral FPI rate of 37% with VHPSD, with left-sided FPI in 63% and right-sided FPI in 46% of cases; these figures were comparable in patients receiving AI-guided ablation [5]. Additional RF applications were most commonly required in the right-sided posterior carina (VHPSD, 25.9%; AI-guided, 25.5%). In the left-sided pulmonary veins, additional applications were required more often in the posterior carina in the VHPSD group (VHPSD, 22.2%; AI-guided 5.9%) and in the anterior carina in the AI-guided group (VHPSD, 7.4%; AI-guided, 15.7%) ($P = 0.049$).

These findings highlight that, although FPI is comparable between the two approaches, overall rates remain suboptimal, with bilat-

Table 1. First-pass isolation (FPI) in selected very high-power, short-duration ablation studies

	Patients, n	Intertag distance, mm	Left-sided FPI, %	Right-sided FPI, %	Bilateral FPI, %
Peller et al. [5]	54	Anterior: 4.5 Posterior: 5	63	46	37
Mueller et al. [7]	42	6	74	52	40
Calvert et al. [8]	51	Anterior: 3–4 Posterior: 5–6	82	75	65
Heeger et al. [9]	699	3–4	77	74	63

eral FPI in just over a third of cases. This contrasts with prior VHPSD studies reporting bilateral FPI rates ranging between 40% and 65% [7–9]. We hypothesize that lesion contiguity as assessed by inter-lesion distance plays an important role in this observed variation, with studies using 6-mm spacing reporting the lowest rates of FPI, and those using 3–4-mm spacing reporting the highest rates (Table 1) [5, 7–9]. We advocate for this closer clustering of lesions, especially on the anterior left atrial wall, and encourage operators to deliver the right-sided wide area circumferential ablation first, allowing time for potential reconnections to emerge during the procedure (with right-sided touch-up applications more likely to be required due to epicardial fibers in this area) [8].

SAFETY, EFFICACY, AND EFFICIENCY OF VHPSD

The authors also report shorter mean procedure times with VHPSD (VHPSD, 127 mins; AI-guided, 160 mins; P <0.01), although complications in the VHPSD group included one peri-procedural stroke and 3 vascular complications (with no such complications in the AI-guided group) [5]. Over median one-year follow-up, atrial arrhythmia recurrence occurred in 28% in the VHPSD group vs. 43.0% in the AI-guided group (P = 0.11); albeit not statistically significant, this numerical difference may be explained by higher rates of persistent AF (VHPSD, 15.9%; AI-guided, 25.3%; P = 0.40) and antiarrhythmic drug use (VHPSD, 13.0%; AI-guided, 5.9%, P = 0.32) in the VHPSD group [5].

The present study's small sample size precludes robust conclusions regarding safety, efficiency, or efficacy. However, the stroke rate of 1.9% (1 out of 54 patients) is concerning, particularly given previous reports of catheter tip coagulum formation in 18% of cases [7]. Fortunately, in the multicenter peqasus VHPSD registry, no strokes or transient ischemic attacks were reported amongst 699 patients, with a major complication rate of 1.6% (predominantly due to vascular access-related complications) [9].

Although short procedural times are often cited as a major advantage of VHPSD PVI, recent analyses suggest that, despite similar acute- and medium-term efficacy, VHPSD is associated with longer procedure times than the pentaspline PFA catheter (VHPSD, 100 minutes; PFA, 70 minutes; P <0.001) [10]. Similarly, as more ablation lesions are often required with VHPSD PVI than with standard power RF (VHPSD, median 87 lesions; RF 50 W, median 58 lesions; P <0.001), overall procedural times are often similar between the two approaches [8]. In this rapidly evolving ablation landscape, speed may no longer be a unique selling point for VHPSD.

VHPSD PVI UNDER MILD CONSCIOUS SEDATION

General anesthesia (GA) availability remains an important factor in ablation modality selection [11]. Most commonly, RF PVI is performed under GA or deep sedation, whereas cryoablation is frequently performed under mild conscious sedation (MCS). The study by Peller et al. [5] adds further support to the feasibility of VHPSD PVI under MCS. Indeed, prior studies have demonstrated that patient tolerability of this approach is comparable to that of cryoablation under MCS [12], with similar lesion metrics and one-year arrhythmia freedom to 50 W RF ablation under GA [8]. Crucially, appropriate patient selection is required with this strategy (e.g., avoiding patients with a body mass index >35 kg/m^2, sleep apnea, or severe anxiety), with effective communication throughout the procedure (e.g., ensuring a light breath hold prior to each 4-sec application to enhance catheter stability) [8]. In the era of PFA — which is challenging to perform under MCS [13] — VHPSD is establishing itself as an effective alternative to cryoablation or standard power RF.

CONCLUSION

With no large-scale head-to-head comparisons between VHPSD and competing ablation modalities for achieving PVI, identifying the role of VHPSD ablation in an electrophysiologist's toolkit is no simple task. Overall, the safety and efficacy of VHPSD appears to be similar to that of standard power RF and other ablation modalities, suggesting that, in experienced hands, it remains a viable approach. As highlighted in the study by Peller et al. [5], an important — and often underreported — advantage of VHPSD is its tolerability under MCS compared with standard power RF and PFA, potentially widening access to centers with limited GA availability. Future studies assessing the cost-effectiveness of VHPSD compared with that of its competitors may further inform practice. Ultimately, only time will tell which ablation modalities and catheters will prosper in this Darwinistic battle for survival of the fittest.

Article information

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