Journal of Interventional Cardiac Electrophysiology (2024) 67:21–23
https://doi.org/10.1007/s10840-023-01599-5

COMMENTARY

Pedal to the metal: is vHPSD RF ablation now reaching its full potential?

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Received: 9 June 2023 / Accepted: 18 June 2023 / Published online: 29 June 2023

Pulsed field ablation (PFA) was recently introduced as an emerging new ablation modality, but radiofrequency (RF) energy remains the cornerstone of AF ablation and is the most common used energy source. High power short duration (HPSD) radiofrequency (RF) ablation, utilizing 45–50 W for durations of 5–15 s per lesion, is increasingly accepted as a safe and effective technique [1]. The next contender in the progression of RF technology, presented in 2019, is very high power short duration (vHPSD) RF ablation technology using a dedicated ablation catheter (QDOT-Micro Biosense Webster, CA, USA) allowing for 90-W applications for a duration of 4 s [2].

The catheter has been developed to reduce the potential dangers of an overheated tip with very high power settings by continuously monitoring the temperature at the surface of the catheter. By utilizing six thermocouples that are integrated into the tip of the electrode instead of one thermocouple for standard irrigated catheters, the target temperature can be automatically controlled by fluid flow management. In comparison to power-controlled HPSD ablation using 45–50 W, temperature-controlled vHPSD ablation at 90 W (QMode +) is supposed to optimize the fast development of shallow lesions for applications in the thin-walled left atrium.

Since its clinical introduction 4 years ago, several refinements of vHPSD protocol were required to translate the optimized lesion creation features in terms of efficiency and safety.

First, in initial reports, coagulum was found in up to 10–18% on the catheter tip [3, 4]. Several software amendments to the RF generator (nGEN) were required, but only partly resolved the issue [3]. Other solutions included the use of a different RF generation (nMARQ) [5] or increase of the baseline circuit impedance via repositioning of the neutral electrode from 90 to 110 Ω to reduce the energy delivery and consequently the temperature of the tissue [3].

Second, an initial first pass isolation (FPI) rate between 43 and 61% was reported in multiple studies from the early adoption phase of vHPSD [2, 3, 5]. While in these studies RF time was low, the overall procedure time was longer compared to studies using HPSD ablation settings. This was probably related to the low FPI rate and the need for identification of residual conduction and additional lesion application. Overall, a slightly higher recurrence rate during the blanking period and a trend towards a lower arrhythmia free survival during follow-up was reported for vHPSD compared to HPSD ablation studies [6]. Of note, in the early phase, vHPSD was not compatible with the CARTO Visitag software, which made accurate tracking of the interlesion distance challenging. Subsequent software enhancements addressed this issue.

What is the status in 2023? Did vHPSD take the curve and is now able to reach its full potential of fast, safe, and persistent PVI?

In this issue of JIICE, Solimene et al. [7] describe their experience using a vHPSD temperature-controlled ablation (90 W, 4 s) protocol. In this single-center study, 164 prospectively enrolled patients underwent vHPSD ablation for the treatment of paroxysmal and persistent AF. Overall, FPI rate was 88%. This was achieved with a median procedure time of 75 min and a median RF time of 5.5 min. No major complications occurred. The 12-month freedom from AF/AT recurrence was 86% in both paroxysmal and persistent patients. Overall, a subset of 9 patients underwent a redo procedure. Out of 36 assessed pulmonary veins, 28 remained isolated, resulting in a PVI durability rate of 78%.

The low reported rate of FPI by previous studies has raised concerns for the durability of the PVI. This is of

This comment refers to the article available at https://doi.org/10.1007/s10840-023-01520-0.

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upmost importance since FPI has been shown to be a powerful predictor of procedural efficacy and procedural efficiency [8]. Solimene et al. [7] confirmed with their study the potential role of reducing the inter-tag maximum distance to ≤ 4 mm anteriorly to create most likely a deeper lesions at the anterior thicker portions comparable to an repetitive application at the same location. This strategy is similar to that used more recently by Heeger et al. [9], who obtained by using this adapted protocol a FPI rate of 74%.

Since 7 of 8 reconnections were found at the ridge or anteriorly of the left pulmonary veins, an alternative strategy is to use conventional ablation (QMODE, 50 W) for the anterior parts and QMODE + (90 W, 4 s) for the posterior segments, which has been proposed by some early adopters.[2] More data to demonstrate whether the use of a double modality reduces the rate of anterior acute reconnections compared to the solely QMODE + modality is needed. Furthermore, in this study, in 97% of cases general anesthesia was used. Whether the usage for GA, however, might affect the generalizability of the proposed workflow is unclear. Furthermore, all cases were performed by four experienced operators after having finished a distinct learning curve. Figure 1 summarizes the evolution of the vHPSD workflow to fully reach its potential.

Although not systematically assessed, no esophageal lesions have been described in this study. In the first clinical study (QDOT-FAST) [2], a hemorrhaging ulcer was seen in 1 of 52 patients and healed with medical therapy. Subsequent studies using systematic endoscopy in all patients showed no evidence of esophageal injury in any patient [3, 5]. The rate of esophageal injury is 0.025% as recently reported in the large POTTER AF registry summarizing 553,729 ablation procedures [10]. Thus, to compare safety regarding these often fatal complications between different modalities would require an immense number of enrolled patients.

A word of caution is nevertheless warranted: although it was initially thought that the safety of vHPSD ablation may be the result of less conductive heating to adjacent tissues due to the lower amount of energy per lesion (90 W*4 s = 360 J) compared to HPSD delivered (50 W*10 s = 500 J), new data showed that conductive heating remains an important contributor to lesion formation due to thermal latency [11]. As such, it might be as well important to avoid overlapping, repetitive vHPSD application without waiting period when ablating around areas of thin tissues or near the esophagus.

PFA is the new modality in the AF world. How does vHPSD compare to PFA? There is currently no direct comparison. In a recent head-to-head comparison between PFA and HPSD RF (50 W), shorter procedure times, but longer fluoroscopy times, higher high-sensitivity cardiac troponin levels, and similar AF-free survival during mid-term follow-up were observed [12].

This analysis by Solimene et al. [7] has shown procedural efficiency and 12-month effectiveness of a vHPSD ablation protocol in a single-center study. The main advantage is the potential to shorten procedure times and retain the versatility of conventional point-by-point catheters to perform additional lesion sets to PVI. If findings can be confirmed, this represents an advancement in temperature-controlled, CF-sensing RF ablation and it seems that vHPSD RF ablation is now able to reach its full potential. However, future studies are required to determine the generalizability of these results in a broader population of patients with AF and to directly compare clinical outcomes with other AF ablation technologies such as PFA. These studies would help define the role for vHPSD ablation in times of other emerging technologies for AF ablation.

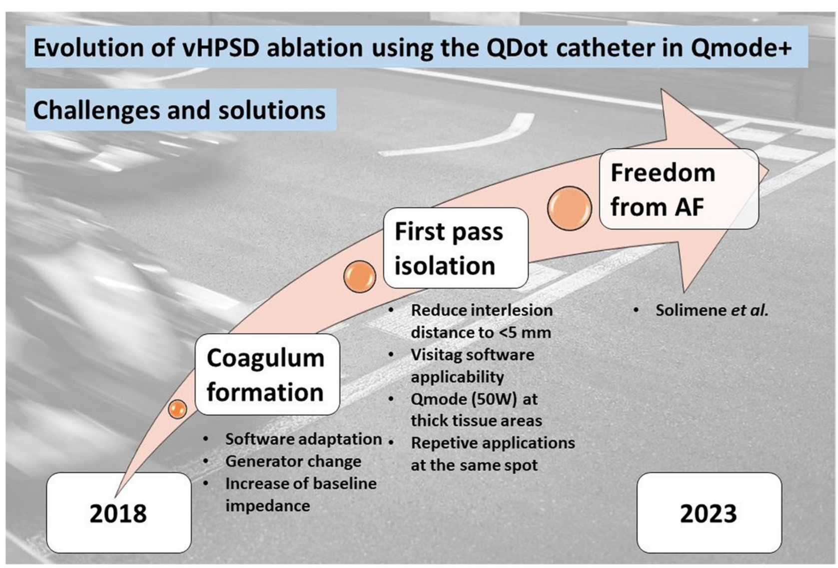

Fig. 1 Proposed measures to optimize vHPSD ablation protocols

Declarations

Conflict of interest Patrick Badertscher has received research funding from the “University of Basel,” the “Stiftung für Herzschrittmacher und Elektrophysiologie,” the “Freiwillige Akademische Gesellschaft Basel,” and Johnson & Johnson, all outside the submitted work and reports personal fees from Abbott. Sven Knecht has received funding of the “Stiftung für kardiovaskuläre Forschung.”

References

1. Badertscher P, Knecht S, Spies F, Völlmin G, Schaer B, Schärli N, Bosshard F, Osswald S, Sticherling C, Kühne M. High-power short-duration ablation index-guided pulmonary vein isolation protocol using a single catheter. J Interv Card Electrophysiol. 2022;65(3):633–42. https://doi.org/10.1007/s10840-022-01226-9.
2. Reddy VY, Grimaldi M, De Potter T, et al. Pulmonary vein isolation with very high power, short duration, temperature-controlled lesions: the QDOT-FAST trial. JACC Clin Electrophysiol Elsevier Inc. 2019;5:778–86.
3. Mueller J, Halbfass P, Sonne K, et al. Safety aspects of very high power very short duration atrial fibrillation ablation using a modified radiofrequency RF-generator: single-center experience. J Cardiovasc Electrophysiol John Wiley and Sons Inc. 2022;33:920–7.
4. Halbfass P, Pavlov B, Müller P, et al. Progression from esophageal thermal asymptomatic lesion to perforation complicating atrial fibrillation ablation: a single-center registry. Circ Arrhythm Electrophysiol. 2017;10:1–10.
5. Halbfass P, Wielandts JY, Knecht S, et al. Safety of very high-power short-duration radiofrequency ablation for pulmonary vein isolation: a two-centre report with emphasis on silent oesophageal injury. Europace Oxford University Press. 2022;24:400–5.
6. Mueller J, Nentwich K, Ene E, Berkovitz A, Sonne K, Chakarov I, Barth S, Waechter C, Behnes M, Akin I, Halbfass P, Deneke T. Radiofrequency ablation of atrial fibrillation-50 W or 90 W? J Cardiovasc Electrophysiol. 2022;33(12):2504–13. https://doi.org/10.1111/jce.15681.
7. Solimene F, Strisciuglio T, Schillaci V, et al. One-year outcomes in patients undergoing very high-power short-duration ablation for atrial fibrillation. J Interv Card Electrophysiol. 2023. https://doi.org/10.1007/s10840-023-01520-0.
8. Osorio J, Hunter TD, Rajendra A, Zei P, Silverstein J, Morales G. Predictors of clinical success after paroxysmal atrial fibrillation catheter ablation. J Cardiovasc Electrophysiol Blackwell Publishing Inc. 2021;32:1814–21.
9. Heeger C-H, Sano M, Ştefan PS, et al. Very high-power short-duration ablation for pulmonary vein isolation utilizing a very-close protocol—the FAST AND FURIOUS PVI study. EP Europace Oxford University Press OUP. 2022;25:880–8.
10. Tilz RR, Schmidt V, Pürerfellner H, Maury P, Chun KJ, Martinek M, et al. A worldwide survey on incidence, management and prognosis of oesophageal fistula formation following atrial fibrillation catheter ablation: the POTTER-AF study. Eur Heart J. 2023;ehad250. https://doi.org/10.1093/eurheartj/ehad250.
11. Nakagawa H, Ikeda A, Sharma T, Govari A, Ashton J, Maffre J, Lifshitz A, Fuimaono K, Yokoyama K, Wittkampf FHM, Jackman WM. Comparison of in vivo tissue temperature profile and lesion geometry for radiofrequency ablation with high power-short duration and moderate power-moderate duration: effects of thermal latency and contact force on lesion formation. Circ Arrhythm Electrophysiol. 2021;14(7):e009899. https://doi.org/10.1161/CIRCEP.121.009899.
12. Badertscher P, Weidlich S, Serban T, Krisai P, Voellmin G, Osswald S, Knecht S, Sticherling C, Kühne M. Pulsed-field ablation versus single-catheter high-power short-duration radiofrequency ablation for atrial fibrillation: procedural characteristics, myocardial injury, and mid-term outcomes. Heart Rhythm. 2023;S1547-5271(23)02220-8. https://doi.org/10.1016/j.hrthm.2023.05.007.