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Original article

Fibrillatory pattern of dissociated venous activity after pulmonary vein isolation: Novel characteristics for remnant foci of a trigger ectopy for atrial fibrillation

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ABSTRACT

Background: Dissociated pulmonary vein activity (DPVA), defined as isolated intrinsic ectopic beats observed after successful pulmonary vein (PV) isolation, indicates the presence of remnant foci of trigger ectopy but has yet to be extensively studied. We investigated the correlation between DPVA and the PV triggers of atrial fibrillation (AF).

Method and results: Consecutive 110 patients undergoing AF ablation were enrolled. We defined trigger ectopy as documented ectopic foci observed to spontaneously initiate AF. Trigger ectopy was detected in 62 (56%) patients. DPVA in at least one PV was detected in 95 (86%) patients. Of the 440 isolated PVs, we recognized trigger ectopy in 73 (16%) PVs (culprit PVs) and DPVA in 184 (42%) PVs. DPVA was more frequently observed in culprit PVs than in non-culprit PVs [59% vs. 39%; odds ratio (OR) = 2.3; $p = 0.001$]. The concordance ratio of culprit PV was 67% (8/12) in PV with fibrillatory DPVA, 20% (35/172) in PV with non-fibrillatory DPVA, and 12% (30/256) in PV without DPVA. Fibrillatory DPVA was more frequently observed in culprit PVs than non-fibrillatory DPVA (OR = 7.8; $p = 0.001$). Non-PV foci were observed in 10 (11%) of the 95 patients with DPVA and 5 (33%) of the 15 patients without DPVA (OR = 4.3; $p = 0.02$). No significant difference in the frequency of AF recurrence was observed between them.

Conclusions: Fibrillatory DPVA was found to be strongly associated with trigger ectopy of AF. Non-fibrillatory DPVA might merely indicate the existence of bystander ectopic foci located inside PVs. Non-PV ectopic foci were frequently observed in patients without DPVA.

Introduction

The pulmonary vein (PV) plays an important role in the arrhythmogenesis of atrial fibrillation (AF). Rapidly firing ectopic foci in PVs have been shown to trigger AF [1,2]. Because the majority of paroxysmal AF episodes are triggered from the PV, electrical PV isolation (PVI) has become an important therapy with a high procedural success rate [3,4]. Spontaneous dissociated PV activity (DPVA), defined as the independent activity within PVs dissociated from the atrial activity, is frequently observed after successful PVI [5–8]. Additional radiofrequency catheter ablation (RFCA) for DPVA can reduce AF recurrence even with the recovery of conduction between the left atrium and PV following PVI [9]. Therefore, we hypothesized that DPVA represents the remaining foci of trigger ectopy and that PVs with DPVA are the culprits of AF. In the present study, we evaluated the association between the PVs with DPVA and those with trigger ectopy.

Further, we investigated the clinical importance of DPVA. Premature atrial contraction that triggers AF is not always identified during procedures, and a proportion of trigger ectopics originate from non-PV regions [10,11]. In such cases, additional ablation of non-PV foci has demonstrated efficacy in improving AF-free survival; however, there is a lack of consensus regarding the most appropriate method for identifying non-PV foci. We hypothesized that DPVA represents remnant foci of previous

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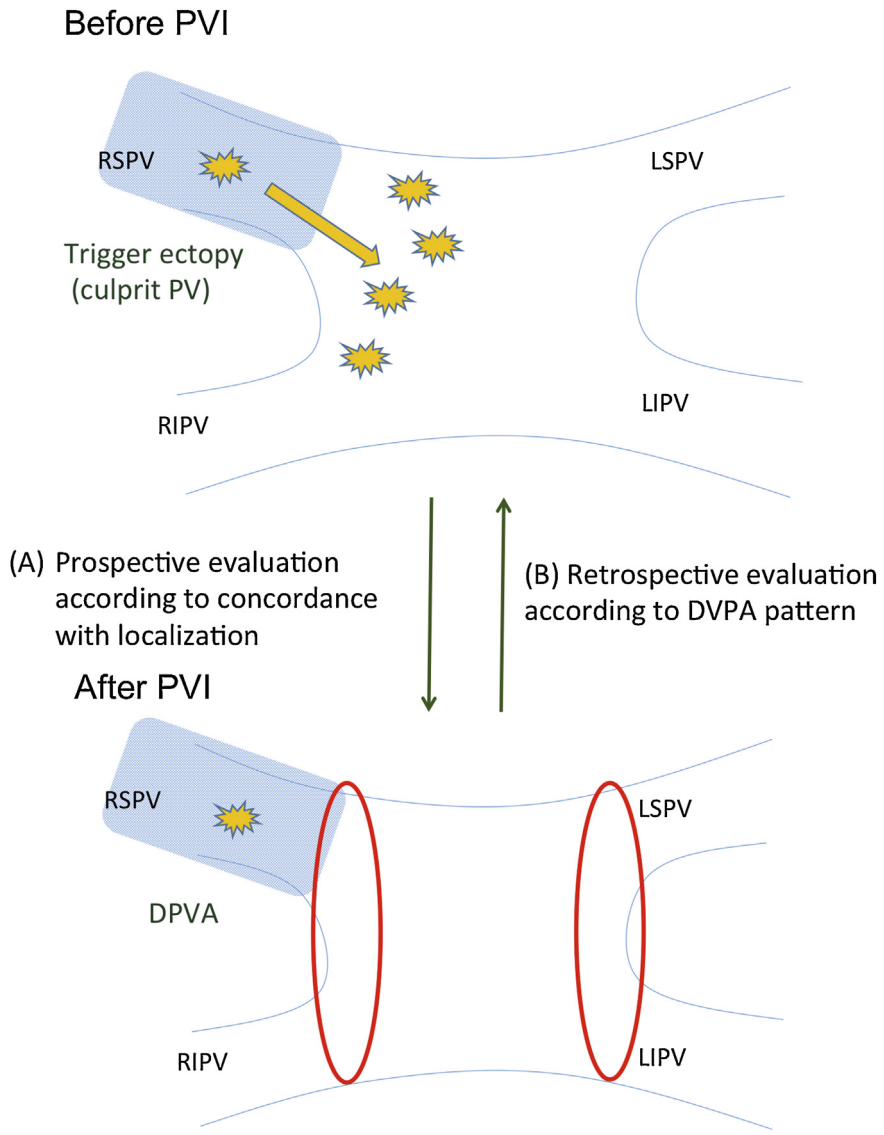

Fig. 1. Schema and objectives of the present study. DPVA are defined as remnant foci of atrial ectopics following PVI. We hypothesized that PVs with DPVA may represent AF culprits. We prospectively and retrospectively evaluated this issue by PV unit. Prospective evaluations were performed to examine the concordance between the locations of DPVA and AF trigger ectopy (A). DPVA may be more frequently observed in culprit PVs than in other PVs. Retrospective evaluations were performed to examine the association between the patterns of DPVA and trigger ectopy (B). AF, atrial fibrillation; DPVA, dissociated pulmonary vein activity; LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; PV, pulmonary vein; RIPV, right inferior pulmonary vein; RSPV, right superior pulmonary vein.

trigger ectopics and that patients without DPVA in any of the four PVs have non-PV foci, which increase the risk of AF recurrence.

First, we examined the concordance ratio of trigger ectopy location and DPVA among the four PVs. We prospectively detected PVs with trigger ectopy (culprit PVs) and examined the frequency of PVs with DPVA following PVI. Further, we retrospectively examined the frequency of PVs with DPVA as culprit PVs according to the pattern of DPVA (Fig. 1). Second, we compared the frequency of non-PV foci and the rate of AF recurrence between the patients with and without DPVA.

Methods

The present study was a single-center, prospective, observational study. We enrolled 110 consecutive patients with paroxysmal or persistent AF undergoing AF ablation. The objectives of this study were to examine the proportion of culprit PVs with DPVA and the association between the presence or absence of DPVA and the frequency of non-PV foci or AF recurrence.

Electrophysiological study

All antiarrhythmic drugs were discontinued for 5–7 days prior to all procedures. Patients with a $CHADS_2$ score ≥ 1 were effectively anticoagulated for ≥ 3 weeks. Transesophageal echocardiography was performed to exclude atrial thrombi. Heparin (5000 IU intravenously) was initially administered prior to transseptal puncture, with additional heparin administered to maintain an activated clotting time >300 s.

After one transseptal puncture, 3 long sheaths (SL0 and LAMP90, St. Jude Medical, Minneapolis, MN, USA) were introduced into the left atrium. Two SL0 sheathes were located in the left superior PV and the right superior PV, respectively, and a LAMP90 sheath was located in the left inferior PV.

Electrophysiological studies were performed under sedation with dexmedetomidine and thiopental sodium. Surface

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