Recurrence of left atrium-pulmonary vein conduction following successful disconnection in asymptomatic patients

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Abstract

Background The clinical significance of conduction recurrences in isolated pulmonary veins of patients with atrial fibrillation is not established.

Methods Twenty-two patients with paroxysmal atrial fibrillation underwent successful pulmonary vein isolation. Six months after the procedure, 14 patients were free of atrial fibrillation. Two of these patients were subjected to repeat mapping of the left superior pulmonary vein.

Results There was recurrence of pulmonary vein to left atrium conduction despite complete lack of symptoms or evidence of recurrent atrial fibrillation.

Conclusion Successful pulmonary vein isolation with abolition of paroxysmal atrial fibrillation does not confer permanent disconnection of the pulmonary vein musculature from the left atrium.

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KEYWORDS

atrial fibrillation; pulmonary vein isolation

Introduction

Isolation of pulmonary veins (PV) via catheter ablation is an established therapeutic option for patients with paroxysmal atrial fibrillation (AF). Several techniques have been applied for electrical isolation of the pulmonary veins (PV-LA disconnection) \cite{1,2,3}. Several groups have reported a 4–10 month incidence of freedom from recurrent AF ranging from 50 to 86% after pulmonary vein isolation and a risk of 1–42% of developing pulmonary vein stenosis or pulmonary vein turbulent flow \cite{1,4,5,6}.

Following this procedure, atrial fibrillation relapse typically occurs due to incomplete isolation or recurrence of PV-LA conduction \cite{6,7}. However, in asymptomatic patients with no evidence of AF recurrence, the long-term characteristics of PV-LA conduction are not known; the natural history of this ablation procedure has not been studied. We present two cases of successful left superior
pulmonary vein isolation in which recurrence of PV-LA conduction was noted 6 months after the procedure despite complete lack of evidence of recurrent atrial fibrillation.

Methods

Twenty-two patients with drug-refractory, symptomatic paroxysmal AF had PV isolation. In the initial five patients, isolation of an arrhythmogenic left superior pulmonary vein (LSPV) was attempted. In the remainder, all PVs were targeted. Patients were studied in the post-absorptive state, under sedation with diazepam and diamorphine, and after beta-blockers or other antiarrhythmic agents had been discontinued for at least 5 days. Amiodarone had been withdrawn at least 2 months before the procedure. Intracardiac thrombi were excluded by transoesophageal echocardiography.

Catheter ablation

Multipolar catheters were introduced into the right atrium along the crista terminalis and the His-bundle area, the coronary sinus, and the left atrium via a single or double transseptal approach. Bipolar electrograms were filtered at 30–500 Hz, amplified at gains of 20–80 mm/mV, and displayed and acquired on a Marquette Midas 8200 or a Bard, LabSystem Duo, together with surface electrocardiograms.

Isolation of the left superior pulmonary vein via partial perimetric ablation was accomplished according to the method described by Haïssaguerre et al. [1]. In brief, following the transseptal puncture, enoxaparin was administered i.v. (1 mg/kg) and pulmonary veins were mapped with a 20 mm Lasso circular electrode (Cordis-Webster). Disconnection of the vein with the left atrial myocardium was performed with a conventional ablation catheter with a 4 mm tip and 2.5 mm interelectrode spacing (Cordis-Webster), and was verified during sinus rhythm and distal coronary sinus pacing. Radiofrequency current was supplied by a 500 kHz generator (Cordis, Johnson and Johnson) at a preset electrical power of 25 W, aiming at a target temperature of 50 °C. End-points of the procedure were elimination of PV muscle conduction distal to the ablation site based on abolition or dissociation of distal PV potentials and elimination of spontaneous or induced ectopy [1,6]. Selective PV
angiography was employed to verify absence of ostial PV stenosis following the procedure.

**Follow-up and remapping**

Following the ablation procedure, patients were subjected to monthly clinical assessment and ambulatory electrocardiographic monitoring at 1, 3, and 6 months. All patients had Holter monitoring and outpatient follow-up, and were instructed to maintain personal records with descriptions of every episode of symptomatic palpitations and, in case of persistent arrhythmia episodes, to obtain electrocardiographic documentation of the underlying rhythm. Six months after the procedure, 14 patients experienced considerable improvement and absence of symptoms. In 10 of these patients, all scheduled Holters were available and confirmed lack of paroxysmal AF. These patients were invited to participate in our remapping protocol with the same technique employed at the initial ablation procedure. Eventually, two of the ten patients with complete lack of symptoms and negative Holters were readmitted for LSPV mapping with the Lasso catheter. The study was approved by our Ethics Committee and patients had provided written, informed consent being fully aware of the investigative nature of the repeat procedure.

**Results**

**Patient 1**

A 58-year-old lady presented with frequent, symptomatic paroxysms of AF (more than twice a week) unresponsive to antiarrhythmic medication, including beta blocker therapy and amiodarone. Clinical investigation was negative and a diagnosis of lone AF was established. At electrophysiological study, both spontaneous and inducible AF were recorded. Spontaneous ectopic activity was noted to originate in the LSPV. The patient underwent successful isolation of the LSPV during AF and sinus rhythm, following 11 RF applications of 1 min each (Figs. 1–3). Fluoroscopy and procedure times were 23 min and 180 min, respectively. She was discharged on no medication following an uneventful procedure and has remained asymptomatic for 6 months. No AF was detected on Holter monitoring performed at 1, 3 and 6 months following the procedure.
**Figure 3** Patient 1. Following successful disconnection no PV potentials are being recorded during distal coronary sinus pacing. Abbreviations as in Fig. 1.

**Figure 4** Patient 1. Mapping of the LSPV during distal coronary sinus pacing. Recurrence of PV activity is clear. Abbreviations as in Fig. 1.
The patient underwent repeat mapping of the left superior pulmonary vein 6 months after ablation. Recurrence of conduction was evident during coronary sinus pacing in all mapped perimetric sites, without evidence of left atrial to PV conduction (Fig. 4). Sustained AF was still inducible with bursts of atrial pacing. No repeat ablation was deemed necessary and 3 months later she remains asymptomatic. An additional Holter was also unremarkable.

**Patient 2**

A 47-year-old hypertensive male treated with an angiotensin receptor blocker and bisoprolol presented with weekly paroxysms of symptomatic atrial fibrillation. He also had a history of two prior electrical cardioversions. He underwent successful isolation of the left superior and inferior PV and a common right PV, following 10, 6 and 12 RF applications of 1 min each, respectively. (Figs. 5 and 6). Fluoroscopy and procedure times were 48 min and 210 min, respectively. Pulmonary vein disconnection was accomplished without any complications and the patient was discharged on the same medications without additional antiarrhythmic agents. During follow-up no AF was detected on 1, 3, and 6-month Holters and the patient remained completely asymptomatic for 6 months following ablation.

Repeat LSPV mapping performed six months following the initial procedure demonstrated recurrence of conduction in at least some of the PV-LA fascicles during distal coronary sinus pacing (Fig. 7). Compared with pre-ablation electrograms, however, there was evidence of slowing of left atrial to PV conduction (Figs. 5 and 7). AF was induced during left atrial pacing and no further PV mapping was conducted. No ablation was performed during this study and 2 months later he remains completely asymptomatic.

**Discussion**

Our results clearly indicate that the disconnection technique employed may not confer permanent interruption of PV muscular conduction to left atrium. However, although PV disconnection clearly eliminates spontaneous paroxysms of AF from the PVs, reappearance of conduction does not necessarily imply clinical recurrence of AF. The
Figure 6  Patient 2. Following successful disconnection no PV potentials are recorded during distal coronary sinus pacing. Abbreviations as in Fig. 5.

Figure 7  Patient 2. Mapping of the LSPV during distal coronary sinus pacing. Recurrence of PV activity is again obvious at dipoles 5–6, 7–8, 9–10. Abbreviations as in Fig. 5.
et al. who have elegantly shown that following 
recurrences did not necessarily denote AF relapse 
lar recurrence rates are observed 5 months later 
following a repeat procedure, simi-
larly isolated PVs had evidence of recovered PV 
activity was recorded following initial disconnec-
tion and engage the AF substrate in the atrium. Other PV 
pathways may not support such frequent conduc-
tion or may enter the atrium at a spot that does 
not allow AF conduction or the substrate to be en-
gaged. Thus, when we disconnect the vein we may 
interrupt additional critical pathways that cannot 
be detected by current mapping techniques. How-
ever, with time these other routes may assume 
greater clinical importance. It is now becoming evi-
dent that PV-left atrial connections are more com-
plex than initially thought [8], and that the ostial 
anatomy of left-sided PVs may not allow precise mapping with a circular catheter [9]. Furthermore, 
the possible effect of local denervation of the gan-
glionic plexus around the superior PV-left atrial 
junctions by the ablation procedure is currently 
being considered [10,11]. This mechanism might 
also be responsible for the diminished episodes of 
PAF, regardless of permanent PV isolation.

Our results are not surprising in the light of re-
cent evidence. In a recent study, 61% of 84 previ-
ously isolated PVs had evidence of recovered PV potentials on reablation [7]. In another study, con-
duction recurrences in isolated veins were ob-
served in approximately 80% of cases 4 months after ablation; following a repeat procedure, simi-
lar recurrence rates are observed 5 months later [12]. However, PV-left atrial junction conduction recurrences did not necessarily denote AF relapse [12]. This observation was also confirmed by Stabile et al. [13] who have elegantly shown that following a successful circumferential ostial PV ablation procedure, electrical isolation of the PVs is not crit-
ical for curing AF. However, although the presented cases indicate that successful PV isolation may not necessitate permanent disconnection of the PV 
musculature from the left atrium, they do not jus-
tify the routine acceptance of incomplete PV iso-
lation as a sufficient end-point of the procedure. 
Despite incomplete isolation, clinical efficacy in 
our patients was accomplished with an initial strat-
ey aimed at achieving complete isolation.

Our study has several limitations. First, both 
cases represent our initial experience with PV iso-
lolation by perimetric ablation. Thus, PV pacing in order to access PV to LA conduction was not performed. We do not know, therefore, whether 
unidirectional block was responsible for the elimi-
nation of AF. In addition, no left atrial appendage 
pacing was employed in order to differentiate re-
corded potentials from far-field left atrial append-
age activity. The fact, however, that no such activity was recorded following initial disconnec-
tion, makes this possibility unlikely. Finally, AF 
could also be triggered from PVs other than the 
LSPV and recurrence of conduction in the LSPV 
did not necessitate recurrence in other veins; com-
plete PV remapping was not performed. This, how-
ever, cannot explain the complete lack of AF 
relapses in the first patient in whom the LSPV only 
was targeted and in which recurrence of conduction 
was obvious. Finally, episodes of asymptomatic 
AF during the follow-up period cannot be 
excluded. However, it has been previously shown that “silent” AF episodes are rather rare in asymptom-

In summary, our observations indicate that suc-
cessful PV isolation does not confer permanent dis-
connection of the PV musculature from the left 
atrium. This does not result in clinical recurrence of AF within the next 6–9 months but the long-term consequences remain unknown. In addition, our 
observations show that current pulmonary vein iso-
lation techniques do not necessarily modify the in-
ducibility of the atria into AF by burst pacing. Our 
observations clearly suggest that long-term fol-
low-up and further research including pulmonary vein remapping is necessary to understand better the consequences of these procedures.

References


