An Increase in Right Atrial Magnetic Strength Is a Novel Predictor of Recurrence of Atrial Fibrillation After Radiofrequency Catheter Ablation

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Background: Differences in electrical properties between left and right atria (LA and RA) after pulmonary vein isolation (PVI) for atrial fibrillation (AF) are currently poorly understood. Magnetocardiograms were used to investigate the effect of PVI on bi-atrial magnetic field changes and their relationship to clinical outcomes.

Methods and Results: This study included 71 patients undergoing PVI for paroxysmal AF. Magnetocardiograms were recorded at baseline and 1 day, 8 weeks, and 24 weeks after ablation. Peak magnitude of LA and RA segments on P waves was separately compared before and after PVI. During a 16-month post-ablation period, 53 (75%) patients were free from AF recurrences. LA magnetic strength in patients without recurrence persistently decreased for 24 weeks and was significantly lower at 8 weeks than that in patients with recurrence (1.28±0.69 vs. 1.74±0.71 pico-Tesla, P=0.02). RA magnetic strength in patients with recurrence persistently rose for 24 weeks and was significantly higher at 8 weeks than that in patients without recurrence (2.17±0.82 vs. 3.00±1.12 pico-Tesla, P=0.001). Multivariate analysis showed RA magnetic strength at 8 weeks to be the strongest predictor of AF recurrence (odds ratio=3.335; 95% confidence interval=1.181–9.416; P=0.02).

Conclusions: PVI resulted in distinct changes in magnetic strength in both the LA and the RA. A persistent rise in RA magnetic strength might be a robust predictor of AF recurrence after ablation. (Circ J 2012; 76: 1601–1608)

Key Words: Atrial fibrillation; Magnetocardiogram; Pulmonary vein isolation (PVI); Right atrium

Pulmonary vein isolation (PVI) for atrial fibrillation (AF) results in significant change in the electrical and structural properties of the left atrium (LA), such as reductions in LA voltage, LA volume, LA transport function, dominant frequency of AF, and P-wave duration. These variables are considered to be predictive of procedural outcomes after catheter ablation of AF. However, it is notable that these investigations generally focused on the direct effect of LA ablation on the LA. The hemodynamic relationship between right atrium (RA) and LA is in tandem. During right ventricular systole, the LA and PVs expand, acting as a reservoir for the blood that has advanced through the pulmonary circuit. This suggests that changes in electrical, structural, and hemodynamic properties in the LA affect those in the RA. Therefore, we thought electrophysiological analyses in both the RA and LA before and after ablation might provide us with further insights into the mechanisms of AF recurrence.

Electrical activity of the heart generates a magnetic field around the chest. The magnetocardiogram (MCG) is a body surface mapping method that non-invasively detects this magnetic field, especially weak electrophysiological phenomena that could be missed by the electrocardiogram (ECG). Because the magnetic field is not distorted by flow through tissues such as lungs, bones, and muscles, the MCG has higher spatial resolution than does the ECG. Because of these unique characteristics, it is possible that changes in RA and LA properties after ablation can be separately investigated with the MCG. The purpose of this study was to evaluate with the MCG both changes in the bi-atrial magnetic field after ablation and the impact of these changes on clinical outcome.
Patient were discharged on warfarin for 10 days after ablation. Post-Ablation Care and Follow up: Patients were seen in an outpatient clinic 2, 8, 16, and 24 weeks after hospital discharge and every 3 months thereafter. Holter (DSC-3300, Nihon Kohden, Tokyo, Japan) or an event recorder (ICG-901, Omron, Kyoto, Japan) was undertaken before each outpatient visit. Treatment success was defined as freedom from all atrial tachyarrhythmias in the absence of antiarrhythmic drug therapy after a blanking period of 8 weeks.

### Methods

#### Study Subjects

The subjects of this study comprised 71 consecutive patients who underwent only antral PVI for treatment of paroxysmal AF. Clinical characteristics of the patients are shown in Table 1. Patients with structural heart disease or who had undergone a prior ablation procedure for AF were excluded from this study.

| Table 1. Characteristics of Patients With and Without Recurrence of AF |
|--------------------------|-----------------|-----------------|-----------------|-----------------|
|                           | All patients (n=71) | Recurrence (n=18) | No recurrence (n=53) | P value |
| Sex (F/M)                | 16/56            | 6/12             | 10/43             | 0.20 |
| Age (years)              | 59±11            | 59±12            | 59±11             | 0.6  |
| Duration of AF history (years)* | Median=2.0, IQ=4.0 | Median=4.5, IQ=8.0 | Median=2.0, IQ=3.0 | 0.13 |
| Body mass index (kg/m²)  | 23±3             | 22±3             | 23±3              | 0.17 |
| LA volume index (ml/m²)  | 28±8             | 28±9             | 27±8              | 0.9  |
| LVEF (%)                 | 68±7             | 69±8             | 67±7              | 0.6  |
| BNP (pg/ml)*             | Median=29, IQ=40 | Median=30, IQ=38 | Median=28, IQ=38  | 0.4  |
| Hypertension (n)         | 43               | 10               | 33                | 0.6  |
| Diabetes (n)             | 15               | 3                | 12                | 0.6  |
| LA pressure (mmHg)       | 13±5             | 12±4             | 13±6              | 0.4  |

*Data are shown as median with IQ because data were not normally distributed.

AF, atrial fibrillation; IQ, interquartile range; LA, left atrial; LVEF, left ventricular ejection fraction; BNP, brain natriuretic peptide.

#### Electrophysiologic Study and Catheter Ablation

The study protocol was approved by the local Institutional Review Board, and all patients provided their informed written consent. All antiarrhythmic drug therapy was discontinued 4–5 half-lives before the procedure except for amiodarone, which was discontinued 8 weeks beforehand. A 7F 14-pole dual-site mapping catheter (Irvine Biomedical Inc., Irvine, CA, USA) was positioned in the coronary sinus and the low lateral wall of the RA throughout the procedure. Three long sheaths (SL0, AF Division, St. Jude Medical, Minnetonka, MN, USA) were then advanced into the LA, and LA pressure was measured just after transseptal puncture using a long sheath connected to a pressure transducer (TruWave, Edwards Lifesciences, Irvine, CA, USA). Following PV angiography, 2 decapolar ring catheters (Lasso, Biosense Webster, Diamond Bar, CA, USA) were placed in the superior and inferior PVS on one side at a time. An open-irrigation, 3.5-mm-tip deflectable catheter (ThermoCool, Biosense Webster) was used for mapping and ablation. Bipolar electrograms were displayed and recorded at filter settings of 30 to 500 Hz during the procedure (CardioLab System, Pruka Engineering, Houston, TX, USA). The LA and PVS were constructed with a 3-dimensional electro-anatomic mapping system (CARTO, Biosense Webster), and an activation map during sinus rhythm was depicted before ablation.

The ipsilateral PV antrum was circumferentially ablated under fluoroscopic, electrogram, and CARTO guidance. Additional approaches to PVI, such as ablation of continuous fractionated electrograms and linear ablation, were not performed. Radiofrequency energy was delivered at a power of 20–35 W, maximal irrigation flow rate of 30 ml/min, and maximal temperature of 42°C. The endpoint of ablation was the elimination of all PV potentials.

#### Post-Ablation Care and Follow up

Patients were discharged on warfarin ≥5 days after ablation. Antiarrhythmic drugs were not prescribed in any patient. Patients were seen in an outpatient clinic 2, 8, 16, and 24 weeks after hospital discharge and every 3 months thereafter. Holter (DSC-3300, Nihon Kohden, Tokyo, Japan) or an event recorder (ICG-901, Omron, Kyoto, Japan) was undertaken before each outpatient visit. Treatment success was defined as freedom from all atrial tachyarrhythmias in the absence of antiarrhythmic drug therapy after a blanking period of 8 weeks.

#### MCG Measurement and Analysis

All patients underwent a MCG during sinus rhythm 1 day before (baseline) and 1 day, 8 weeks, and 24 weeks after ablation. In patients who underwent a second ablation procedure after AF recurrence, the MCG was repeated 8 weeks after the second ablation. MCG methodology was described in detail previously.10 We used an MC-6400 MCG system (Hitachi High-Technologies Corporation, Tokyo, Japan) with 64 magnetic sensors to measure the normal component of the magnetic field. The magnetic sensors were in an 8×8 matrix with a pitch of 25 mm and a measurement area of 175×175 mm. MCG signals from each subject were recorded in the resting state from the front and back planes in a magnetically shielded room. The sampling rate was 1 kHz, and the measurement period was 2 min. The MCG signals were passed through a 0.1- to 50-Hz bandpass filter and a 50-Hz power line noise filter. The MCG signals were averaged over 60 beats to reduce the noise component in the signals. Magnetic strength in pico-Tesla (pT) is shown as an absolute value in this study.

The beginning and end of the P wave on the frontal- and back-plane MCG waveforms were automatically detected based on the fit of the quadratic function.12 The P wave on the MCG waveforms was divided into 2 segments (RA and LA) at the maximal slope point of the tangent to the MCG waveforms during the P wave. P-wave duration and maximal magnitude in each segment were automatically calculated and manually confirmed by physicians blinded to the clinical outcomes (Figure 1).

#### Statistical Analysis

Continuous variables with a normal distribution are expressed as mean±1 standard deviation and were compared by using a Student’s t-test or paired t-test. The duration of AF history and brain natriuretic peptide level are presented as median with interquartile range because the data were not normally distributed and were compared by using Welch t-tests. Categorical
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variables were compared by using chi-squared analysis. Continuous variables among MCG measurements at several time points before and after ablation were compared with repeated measures analysis of variance. Post-hoc analyses were performed using the Scheffé test. Multivariate logistic regression analysis was performed to identify the predictors of recurrence of AF after ablation. Univariate variables with a value of P<0.2 were included in the multivariate analysis. A 2-tailed P value of <0.05 indicated statistical significance.

Results

Clinical Outcomes After Ablation
Complete PVI was achieved in all patients. Among the 71 patients, 53 (75%) were free from AF recurrence during a mean follow-up period of 16±6 months after a single ablation procedure. An early recurrence within the 8-week blanking period occurred in 24 of the 71 (34%) patients. Although 10 (42%) patients did not experience recurrent AF thereafter, patients without early recurrence had a better mid-term prognosis than patients with early recurrence (log rank P<0.0001). Fifteen of the 18 patients who experienced AF recurrence underwent a repeat ablation procedure. PV-LA reconnections were seen in all 15 of these patients, and all reconnections were successfully re-isolated. Duration of radiofrequency application was 39±14 min at the index procedure and 15±6 min at the second procedure (P<0.0001).

Effect of Ablation on Heart Rate
Heart rate was significantly increased from baseline (59±10 beats/min) to 1 day after ablation (74±12 beats/min). Although it dropped significantly at 8 weeks (68±10 beats/min) and 24 weeks after ablation (67±10 beats/min), it was still higher than that at baseline (P<0.0001) (Figure 2A). Heart rate was not significantly different between patients with and without AF recurrence at any time.

Effect of Ablation on P-Wave Duration on the MCG
P-wave duration on the MCG significantly decreased in the frontal plane from the baseline value of 117±15 ms to 112±14 ms at 1 day, 113±15 ms at 8 weeks, and 112±16 ms at 24 weeks after ablation (P=0.0005) and in the back plane from the baseline value of 119±17 ms to 109±21 ms at 1 day, 112±21 ms at 8 weeks, and 112±16 ms at 24 weeks after ablation (P<0.0001). The trend from the frontal plane was similar to that from the back plane (P=0.003) (Figure 2B). However, the peak magnitude of the RA segment from the frontal plane significantly increased from baseline (2.57±1.18 pT) to 1 day after ablation (3.00±1.38 pT) and then returned to the baseline level at 8 weeks (2.38±0.96 pT) and 24 weeks (2.49±1.38 pT) after ablation (P<0.0007). The trend from the back plane was similar to that from the frontal plane.
Early Recurrence and MCG Parameters

Because there was no significant impact on early recurrence or mid-term outcome from the difference between data from the frontal and back planes, only data from the frontal plane is shown.

There was a trend towards higher RA magnetic strength at baseline in patients who had early recurrence than in patients who did not (2.94±1.31 vs. 2.38±1.08 pT, P=0.06). Besides, RA magnetic strength 1 day after ablation was significantly higher in patients with early recurrence than in patients without (3.50±1.76 vs. 2.72±1.00 pT, P=0.02). There were no significant differences in LA magnetic strength between patients with and without early recurrence.

Mid-Term Outcome and MCG Parameters

LA Segment on the MCG

Duration between P-wave onset and the peak of the LA segment was 96±12 ms. An activation map of the LA during sinus rhythm was depicted by CARTO in 48 patients and the earliest activity was seen 45±7 ms after onset of the P wave. In patients without AF recurrence, the decrease in the peak magnitude of the LA segment persisted after ablation (1.64±0.80 pT at baseline; 1.47±0.84 pT at 1 day, 1.28±0.69 pT at 8 weeks, and 1.24±0.64 pT at 24 weeks after ablation; P<0.0001) (Figure 3A). In patients with AF recur-
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The peak magnitude of the LA segment did not change after ablation (1.80±0.71 pT at baseline; 1.63±0.78 pT at 1 day, 1.74±0.71 pT at 8 weeks, and 1.82±0.77 pT at 24 weeks after ablation; P=0.7) (Figure 3A). A comparison of peak magnitude of the LA segment at each time between patients with and without AF recurrence showed that patients without recurrence had a lower peak magnitude of the LA segment at 8 weeks (P=0.02) and 24 weeks after ablation (P=0.005) than patients with recurrence (Figure 3A).

**RA Segment on the MCG** Duration between P-wave onset and the peak of the RA segment was 41±7 ms. In patients without AF recurrence, the peak magnitude of the RA segment increased significantly from baseline (2.54±1.14 pT) to 1 day after ablation (2.95±1.39 pT) and then dropped to a level below that of the baseline value at 8 weeks (2.17±0.82 pT) and 24 weeks after ablation (2.13±0.83 pT) (P<0.0001) (Figure 3B). However, in patients with AF recurrence, RA magnetic strength rose from baseline (2.58±1.18 pT) to 1 day after ablation (3.20±1.39 pT) and persisted until 24 weeks after ablation (3.11±1.27 pT) (P=0.04) (Figure 3B). A comparison of peak magnitude of the RA segment at each time between patients with and without AF recurrence showed that patients with recurrence had a significantly higher peak magnitude of the RA segment at 8 weeks (P=0.001) and 24 weeks after ablation (P=0.001) than patients without recurrence (Figure 3B).

**Changes in Magnetic Strength and v Wave Amplitude After the Second Ablation** Among patients who were free from AF recurrence after the second procedure, there was no change in magnetic strength in the RA segment (3.11±1.27 vs. 2.81±1.68 pT, P=0.9) between the 24 weeks after the first procedure and the 8 weeks after the second procedure. However, there was a trend toward lower magnetic strength of the LA segment after the second procedure than that after the first procedure (1.82±0.77 vs. 1.43±0.70 pT, P=0.07) (Figure 1B). There was no significant difference in the v wave amplitude between patients with and without recurrence at the index procedure (12±4 vs. 13±6 mmHg, P=0.4). However, among the patients who underwent a second ablation procedure, the v wave measured at the second procedure was significantly higher than that measured at the index procedure (12±4 vs. 17±7 mmHg, P=0.02).

**Multivariate Analysis**

Parameters with a value of P<0.2 in univariate analysis, body mass index, duration of AF history, and peak magnitude of the RA or LA segment 8 weeks after ablation, were applied to multivariate analysis. Peak magnitude of the RA segment 8 weeks after ablation (odds ratio=3.335; 95% confidence interval=1.181–9.416; P=0.02) was the only independent predictor of AF recurrence (Table 2).

**Discussion**

**Main Findings**

This study showed that: (1) LA magnetic strength persistently decreased for 24 weeks after ablation, suggesting a direct effect of PVI on the LA; (2) RA magnetic strength after ablation showed a biphasic response, suggesting an indirect effect of PVI on the RA; (3) RA magnetic strength 1 day after ablation was associated not with the midterm outcome but with early recurrence of AF; (4) patients without AF recurrence had a significantly lower peak magnitude of both LA and RA segments at 8 weeks after ablation than patients with AF recurrence, indicating an apparent association between electrical silence of the atria and favorable outcome after ablation; and (5) the magnitude of the RA segment was shown by multivariate analysis to be the only independent predictor for recurrence of AF.

**Figure 3.** (A) Difference in the peak magnitudes of the LA segment at each time between patients with and without recurrence of AF. Magnetic strength of the LA segment was significantly lower in patients without recurrence of AF at 8 and 24 weeks after ablation. *P<0.05 vs. 1 day after ablation. †P<0.01 vs. baseline. (B) Difference in peak magnitudes of the RA segment at each time between patients with and without recurrence of AF. Magnetic strength of the RA segment was significantly higher in patients with recurrence of AF at 8 and 24 weeks after ablation. *P<0.05 vs. baseline. †P<0.001 vs. 1 day after ablation. AF, atrial fibrillation; LA, left atrium; RA, right atrium; pT, pico-Tesla.
To the best of our knowledge, this is the first study to show that magnetic/electric strength significantly fluctuates with different patterns after ablation, not only in the LA but also in the RA, and that RA magnetic strength might be a robust predictor of AF recurrence after ablation.

**Definition of RA (Initial) and LA (Final) P-Wave Segments on the MCG**

There is consensus that on the ECG, atrial activation early in the P wave is oriented primarily anteriorly over the RA and later posteriorly over the LA. A recent study imparted new knowledge by precisely analyzing the genesis of the P wave on the ECG in patients with paroxysmal AF using both endocardial and epicardial 3D mapping. The authors showed that the early ~50 ms of the P wave were derived from RA activation alone, except for that from Bachmann’s bundle. Also in the present study, LA activation on the CARTO map began on average 45 ms after the onset of the P wave. Because the duration between P-wave onset and the peak of the RA segment was ~50 ms in 69/71 (97%) patients, these results suggest that the RA mostly, if not in all cases, contributes to the formation of the peak of the RA segment. Similarly, RA activation ends ~90 ms following sinus node activation. The duration between P-wave onset and the peak of the LA segment was >90 ms in 57/71 (80%) patients in this study. It is thus reasonable to suggest that the peak magnitude of the LA segment in the present study represents mostly the electrical activity of the LA.

**Decrease in LA Magnetic Strength and Clinical Outcome After Ablation**

Successful antral PVI directly renders a large area including the 4 PVs, the PV antra, and the posterior wall as electrically silent. A recent non-invasive study using magnetic resonance imaging showed that a greater degree of LA wall injury from radiofrequency ablation predicts better procedural outcome. Udyavar et al. invasively investigated acute changes in the intracardiac electrogram immediately after PVI and reported that patients with AF recurrence had less voltage reduction in the LA wall than those without AF recurrence. The significant decrease in magnetic strength of the LA in the present study might reflect the achievement of complete PVI with transmural penetration of ablation lesions and adequate posterior wall debulking with permanent tissue injury, which are associated with favorable outcomes. The decrease in LA magnetic strength after re-isolation of the PV reconnections, which was achieved by a smaller number of radiofrequency applications than at the index procedure, suggests a close relationship between LA magnetic strength and PV isolation.

**Increase in RA Magnetic Strength 1 Day After Ablation**

Magnetic strength of the RA increased significantly 1 day after ablation in patients both with and without AF recurrence. Considering that heart rate dramatically increased immediately after ablation, it is possible that autonomic nervous activity is associated with the rise of RA magnetic strength. There are several factors that affect autonomic nervous activity in the post-ablation period. Volume overload associated with the use of an open-irrigation catheter might cause atrial stretch during the procedure. This stimulus is known to elicit changes in sympathetic nerve activity that include an increase in heart rate. Antral PVI often involves ablation of the autonomic neurons in the ganglionated plexi. The effect of the inflammatory process and pericarditis occurring immediately after ablation, resulting in a rise in C-reactive protein level and body temperature, are also possible mechanisms of increase in heart rate and magnetic strength. Because these factors are usually transient phenomena after ablation, it might account for the results of the present study that RA magnetic strength 1 day after ablation was not predictive of mid-term outcomes but was predictive of early recurrence after ablation.

**RA Magnetic Strength 8 and 24 Weeks After Ablation**

The RA magnetic strength dropped significantly at 8 weeks after ablation in patients with stable sinus rhythm. It is well known that 1–3 months, a period referred to as the “blanking period”, is necessary for complete maturation of the radiofrequency ablation lesion. A previous study using electron beam tomography reported that LA edema was observed in all patients immediately after antral PV isolation, but disappeared naturally. Resolution of LA edema and subsequent partial recovery of LA transport function stabilizes left-sided hemodynamics and then reduces sympathetic nervous activity. In contrast, the rise in RA magnetic strength persisted until 24 weeks in patients with AF recurrences. Although the mechanisms underlying this condition are not clear, possible causes are pre-existing left ventricular hypertrophy, diastolic dysfunction, continuous inflammatory process, and “stiff LA syndrome”. The principal feature of stiff LA syndrome is right heart failure disproportionate to left heart failure due principally to reduced LA compliance or LA diastolic dysfunction. A recent study reported that one of causes of the syndrome was LA ablation for AF, which leads to scar tissue formation in the LA and PVs and reduction in the LA compliance. Because LA compliance is well reflected by the v wave in the absence of mitral regurgitation, the increased v wave amplitude at the second procedure suggests the important role of this syndrome in the recurrence of AF. Herein, we have to take into account the possibility that the syndrome is underestimated in clinical practice because patients with stiff LA are not always symptomatic. This type of pressure and volume overload that occurs in the RA can become a possible factor to increase magnetic strength in the RA after ablation not transiently but consistently. This irreversibility persisted even after re-isolation of PVs at the second procedure.

**LA vs. RA as a Predictor for Clinical Outcomes**

Extensive PV antral isolation was performed in the LA, where-

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**Table 2. Factors Predicting Recurrence of AF by Multivariate Analysis**

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<th>P value</th>
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<th>95%CI</th>
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<tbody>
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<td>Body mass index</td>
<td>0.9</td>
<td>0.993</td>
<td>0.800–1.232</td>
</tr>
<tr>
<td>Duration of AF history</td>
<td>0.06</td>
<td>1.146</td>
<td>0.993–1.322</td>
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<tr>
<td>LA magnetic strength 8 weeks after ablation</td>
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<td>0.857</td>
<td>0.181–2.391</td>
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<tr>
<td>RA magnetic strength 8 weeks after ablation</td>
<td>0.02</td>
<td>3.335</td>
<td>1.181–8.416</td>
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AF, atrial fibrillation; OR, odds ratio; CI, confidence interval; LA, left atrial; RA, right atrial.
as no radiofrequency ablation was delivered to the RA. This implies that the RA could more purely respond to the changes in autonomic activity, inflammation, and hemodynamic status after ablation than the LA. LA properties are difficult to evaluate while LA edema remains, which is consistent with the result that the LA magnetic strength 1 day after ablation could not predict early recurrence in contrast to the RA magnetic strength. These results suggest the negative impact of LA edema on prediction power of the LA magnetic field and support the result that the magnetic field of the edema-free RA is a more robust surrogate for susceptibility to AF recurrence than the LA.

**Mechanism of AF Recurrence After Ablation**

In the majority of patients, AF recurs in association with recovered PV conduction. However, the suggestion that AF originates from the interaction of a trigger and a substrate is also important. This notion was recently supported by 2 human studies. One reported that even patients with paroxysmal lone AF have an abnormal atrial substrate characterized by lower atrial voltage, conduction abnormalities, and sinus node dysfunction. The other study reported a crucial fact that PV disconnection persisted in only ~40% of the previously isolated PVs even in patients with stable maintenance of sinus rhythm. These data suggest that the presence of an arrhythmogenic substrate in addition to PV reconnection makes the atria more susceptible to recurrent AF than does PV reconnection alone. If one applies the results from the present study to this notion, the fluctuation of magnetic strength in the RA might reflect the presence of an arrhythmogenic substrate.

**P-Wave Duration**

Shortening of the P-wave duration after PVI suggests that the last component of the P wave represents the activation of the left PVs. An absence of reduction in P-wave duration after ablation on the signal-averaged ECG has been raised as a risk factor for recurrence of AF. The most likely reason for the discrepancy in the predictive power of P-wave duration between the signal-averaged ECG and MCG is a difference in methodology, that is, recording resolution, filter settings, and the number of channels included. The influence of atrial repolarization signals (Ta wave) on the end of the P wave, which makes measurements of P-wave duration inaccurate, might be greater on MCG than on ECG.

**Study Limitations**

A major limitation of this study is its small sample size. It was underpowered to detect the best cut-off value of the RA magnetic strength to predict clinical outcomes. In addition, LA-PV reconnection is one of the most robust predictors for AF recurrences. However, it was not included in the analysis in the present study because its prevalence could not be evaluated in patients who were free from AF recurrences and who did not undergo a redo procedure.

**Conclusion**

The MCG detected distinct changes in the magnetic field after PVI, not only in the LA but also in the RA. In particular, a rise in RA magnetic strength might reflect susceptibility to AF recurrence and might predict AF recurrence after ablation. Further studies are needed to define the mechanistic and pathologic relevance of these MCG changes in relation to the recurrence of AF after ablation.

**Disclosures**

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**References**

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