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Pre-Procedural Serum Atrial Natriuretic Peptide Levels Predict Left Atrial Reverse Remodeling After Catheter Ablation in Patients With Atrial Fibrillation

Koki Nakanishi, MD,[a] Shota Fukuda, MD,[b] Hajime Yamashita, MD,[a] Michihiko Kosaka, MD,[a] Naoya Shirai, MD,[a] Atsushi Tanaka, MD,[c] Junichi Yoshikawa, MD,[d] Kenei Shimada, MD[e]

ABSTRACT

OBJECTIVES This study aimed to investigate the role of atrial natriuretic peptide (ANP) levels to predict left atrial (LA) reverse remodeling in atrial fibrillation (AF) patients.

BACKGROUND Although LA reverse remodeling after radiofrequency catheter ablation (RFCA) for AF was reported to be associated with favorable outcomes and improvement of LA and left ventricular function, the predictor has not been extensively evaluated.

METHODS This study included 104 consecutive patients who underwent RFCA for AF. All patients underwent multidetector computed tomography examination and laboratory tests, including measurement of ANP, plasma B-type natriuretic peptide (BNP), and high-sensitivity C-reactive protein (hs-CRP) levels before and 6 months after RFCA. The study population was divided according to the extent of the decrease in the LA volume index at follow-up; responders were defined as patients who exhibited a ≥15% decrease in the LA volume index.

RESULTS At follow-up, 49 patients (47%) were classified as responders. Pre-procedural serum ANP and BNP levels were significantly higher in the responders than in the nonresponders (both $p < 0.01$). In the responders, a significant decrease was observed in the log ANP, log BNP, and log hs-CRP levels from baseline to follow-up (all $p < 0.01$). Multivariate linear regression analysis revealed that log ANP levels before RFCA and maintenance of sinus rhythm during follow-up were independent predictors of LA reverse remodeling (both $p < 0.01$).

CONCLUSIONS In this study, 47% of the patients exhibited LA reverse remodeling after RFCA for AF, with a concomitant improvement in serum ANP, BNP, and hs-CRP levels. The pre-procedural ANP level and maintenance of sinus rhythm were independently associated with LA reverse remodeling. (J Am Coll Cardiol EP 2016;2:151–8)

Atrial fibrillation (AF) is the most common cardiac arrhythmia encountered in clinical practice and is associated with atrial remodeling; the hallmark of structural remodeling is atrial dilatation (1,2). Radiofrequency catheter ablation (RFCA) is considered a reasonable treatment option for patients with symptomatic drug-refractory AF (3), and successful RFCA is known to be associated with a decrease in left atrial (LA) volume (reverse remodeling) (4–6). However, the degree of reverse remodeling varies among individuals (7,8), and this predictor has not been evaluated extensively. Because LA reverse

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From the [a]Department of Cardiovascular Medicine, Baba Memorial Hospital, Sakai, Japan; [b]Second Department of Internal Medicine, University of Occupational and Environmental Health, School of Medicine, Kitakyushu, Japan; [c]Department of Cardiovascular Medicine, Wakayama Medical University, Wakayama, Japan; [d]Nishinomiya Watanabe Cardiovascular Center, Nishinomiya, Japan; and the [e]Department of Internal Medicine and Cardiology, Osaka City University Graduate School of Medicine, Osaka, Japan. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

ANP = atrial natriuretic peptide

BNP = B-type natriuretic peptide

ECG = electrocardiography

hs-CRP = high-sensitivity C-reactive protein

LA = left atrium

LV = left ventricle

MDCT = multidetector computed tomography

PV = pulmonary vein

RFCA = radiofrequency catheter ablation

remodeling leads to subsequent improvement in the LA (9) and left ventricular (LV) function (10), prediction of reverse remodeling is of crucial importance.

Atrial natriuretic peptide (ANP) is a hormone released from atrial myocytes in response to volume or pressure overload (11). Although elevated plasma ANP levels are frequently observed in AF patients (12-14), data indicate that ANP levels are low in patients with advanced atrial fibrosis (15,16). Thus, we hypothesized that elevated ANP levels in AF patients partially reflect the viability of LA myocytes, which may result in a considerable decrease in LA volume after RFCA. This study aimed to investigate the role of ANP levels to predict LA reverse remodeling in patients who underwent RFCA for AF.

SEE PAGE 159

METHODS

STUDY POPULATION. The study population consisted of 104 consecutive patients who had paroxysmal ($n = 65$) and persistent AF ($n = 39$) refractory to antiarrhythmic treatment and who were referred to undergo RFCA first. The exclusion criteria were: 1) history of myocardial infarction; 2) moderate or severe valvular disease; 3) dilated or hypertrophic cardiomyopathy; 4) thyroid dysfunction; and 5) renal insufficiency (serum creatinine level ≥1.5 mg/dl). AF was defined as paroxysmal when the arrhythmia self-terminated within 7 days and as persistent when the AF episode persisted for 7 days, or pharmacological or electrical cardioversion was required to terminate the arrhythmia (17). Self-reported AF burden was evaluated on the basis of a modified arrhythmia frequency and severity scale, from 1 to 10 points for each frequency and duration of AF episodes (range 2 to 20) (18,19). All patients underwent multidetector computed tomography (MDCT) examination 7 ± 3 days before and 6 months after RFCA. Laboratory tests, including measurement of ANP, plasma B-type natriuretic peptide (BNP), and high-sensitivity C-reactive protein (hs-CRP) levels were performed before RFCA on the day of ablation and at 6-month intervals after RFCA. This study was approved by the institutional review board of Baba Memorial Hospital, and written informed consent was obtained from all patients.

MEASUREMENT OF ANP, BNP, AND hs-CRP. Blood samples were collected from the antecubital vein after patients rested in the supine position for ≥30 min. All samples were drawn in the morning before taking medication. Samples were collected in tubes containing 1.25 mg/ml of ethylenediaminetetraacetic acid and a protease inhibitor, aprotinin 500 KIU/ml (for measurement of ANP and BNP). The plasma was separated by centrifugation (at 2,500 rpm) for 10 min at 20°C and stored at −70°C until measurement. Serum ANP concentration was measured with the HISCL ANP immunoassay (Shionogi, Osaka, Japan), and the BNP concentration was measured with the ARCHITECT BNP immunoassay (Abbott Laboratories, Abbott Park, Illinois). hs-CRP was analyzed with the CardioPhase hs-CRP assay (Siemens Healthcare Diagnostics, Marburg, Germany).

SCAN PROTOCOL AND INTERPRETATION OF CT FINDINGS. MDCT examination was performed using the Aquilion 64-detector scanner (Toshiba Medical Systems, Tokyo, Japan) before and 6 months after RFCA. A retrospective electrocardiography (ECG)-gated, contrast-enhanced scan was performed with a slice collimation of 64×0.5 mm, tube rotation time of 400 to 500 ms (as determined by the heart rate), tube voltage of 120 kV, and tube current of 350 to 500 mA depending on patient size. Automated detection of peak enhancement in the ascending aortic arch was used for timing of the scan. For contrast-enhanced scans, 50 to 80 ml of a nonionic contrast agent (Iopamidol 370, Hikari Co., Tokyo, Japan) was injected intravenously at a flow rate of 4.0 to 5.5 ml/s, followed by 40 ml of saline solution at a rate of 5 ml/s. The raw data were reconstructed using algorithms optimized for ECG-gated multislice spiral reconstruction. Images were transferred to a commercially available workstation, SYNAPSE VINCENT (Fujifilm Medical Co., Tokyo, Japan). All MDCT analyses were performed by experienced physicians blinded to other information. The following parameters were assessed.

1. The LA volume was measured using Simpson's rule at end-systole. Pulmonary veins (PVs) and the LA appendage were carefully excluded.
2. Manual planimetry of the endocardial and epicardial LV borders (to define the LV myocardial area) was performed at end-diastole, on short- and long-axis images. The LV volume was calculated using the modified Simpson's method, in which the sum of the cross-sectional areas was multiplied by the sum of slice thicknesses. The LV papillary muscles were excluded from the mass measurement. The LV mass was calculated using the following formula: 1.05 g/ml × LV volume.

The LA volume and LV mass were indexed for body surface area.

PV ISOLATION PROCEDURE. RFCA was performed under sedation. All antiarrhythmic medications except amiodarone were discontinued for at least 5 half-lives before the procedure in all patients. Catheterization into the LA was performed using a 1-puncture and 3-sheath technique. Intravenous heparin was administered to maintain an activated clotting time of ≥300 s after the atrial transseptal procedure. A 3-dimensional geometry of the LA was reconstructed using the EnSite Velocity system (St. Jude Medical, St. Paul, Minnesota). A temperature probe (SensiTherm, St. Jude Medical) containing 3 thermocouples was placed in close proximity to the ablation site for luminal esophageal temperature monitoring. Circumferential PV isolation was performed using a 3.5-mm irrigated-tip catheter (Cool Path Duo, St. Jude Medical) in all patients. We used 2 circular mapping catheters (Lasso, Biosense Webster, Irvine, California; and Optima, St. Jude Medical) to confirm the isolation of the PVs. Radiofrequency energy was delivered at each site or area at a power of 20 to 25 W (posterior LA) and 25 to 35 W (anterior LA) using irrigation rates of 13 to 17 ml/min to achieve the desired power delivery. Successful ablation was defined by a bidirectional block between the LA and the inside of the circumferential PV isolation area and confirmed on electrograms recorded by the circular mapping catheters and pacing maneuvers.

FOLLOW-UP AND DEFINITION OF LA REVERSE REMODELING. After the first procedure, all patients underwent a follow-up evaluation every 1 to 2 months in the outpatient clinic. Discontinuation of the antiarrhythmic medications was recommended 2 months after RFCA. The presence of AF and/or atrial tachycardia was evaluated on the basis of symptoms, ECG recordings, event recordings, and 24-h ambulatory monitoring (3 and 6 months after RFCA). Arrhythmia recurrence was identified by symptoms with ECG documentation of an atrial tachyarrhythmia lasting ≥30 s on a 12-lead ECG, event recording, or Holter monitor recording after a 2-month blanking period from the RFCA procedure.

To study the determinants of LA reverse remodeling after catheter ablation, the study population was divided into 2 groups according to the extent of decrease in the LA volume index during follow-up. Responders were defined as patients who exhibited a ≥15% decrease in the LA volume index at 6 months after RFCA (8,20). Nonresponders were defined as patients who exhibited a <15% decrease or an increase in the LA volume index on MDCT 6 months after RFCA.

STATISTICAL ANALYSIS. Categorical variables are presented as numbers (%); they were compared using the chi-square test. Continuous variables are expressed as mean ± SD; they were compared using the Student *t* test or paired *t* test. The Mann-Whitney *U* test was used for continuous variables that were highly skewed. Correlation analysis was performed using the Pearson correlation test. To evaluate the potential predictors of reverse remodeling, univariate linear regression analysis of baseline clinical, laboratory, echocardiographic, and MDCT parameters was performed first. The independent predictors of LA reverse remodeling were obtained by performing a multivariate linear regression analysis. Variables with $p < 0.10$ in the univariate analysis were included. The sensitivity and specificity of the cutoff point for the prediction of reverse remodeling were determined using receiver-operating characteristic curves. Differences were considered statistically significant at $p < 0.05$.

Interobserver variability of the LA volume index measured by MDCT was analyzed in 30 randomly selected patients assessed by 2 independent blinded observers. Intraobserver variability was analyzed in another group of 30 patients by the same observers at 2 different time points. The results were analyzed by both least-squares-fit linear regression analysis and the Bland-Altman method.

RESULTS

STUDY POPULATION. The baseline characteristics of the total study population are listed in Table 1. AF was paroxysmal in 65 patients (63%) and persistent in 39 patients (37%). Of the 104 patients, 43 patients were in AF rhythm and 61 patients were in sinus rhythm at blood sampling before RFCA. Significant differences were observed between AF rhythm and sinus rhythm in the pre-procedural ANP (75 ± 40 pg/ml vs. 37 ± 28 pg/ml; $p < 0.001$) and BNP (103 ± 61 pg/ml vs. 43 ± 41 pg/ml; $p < 0.001$) levels. At the blood sampling 6 months after RFCA, 17 patients presented in AF rhythm and 87 patients presented in sinus rhythm. There was significant difference in serum ANP level (54 ± 34 pg/ml vs. 35 ± 22 pg/ml; $p = 0.004$), but not in serum BNP level (74 ± 56 pg/ml vs. 49 ± 49 pg/ml, $p = 0.07$), between AF rhythm and sinus rhythm at 6 months after RFCA. Patients with a higher AF burden (AF burden score ≥13; n = 54) had significantly elevated pre-procedural ANP (64 ± 41 pg/ml vs. 40 ± 31 pg/ml; $p = 0.001$) and BNP (89 ± 60 pg/ml vs. 45 ± 47 pg/ml; $p < 0.001$) levels than those with a lower AF burden (AF burden score <13; n = 50). During the 6-month follow-up, 75 patients (72%) remained in sinus rhythm, whereas 29 patients (28%) had a recurrence of AF.

TABLE 1 Patient Characteristics of the Study Population

	All Patients (n = 104)	Responders (n = 49)	Nonresponders (n = 55)	p Value
Age, yrs	68 ± 8	69 ± 7	67 ± 9	0.3
Male	68 (65)	31 (63)	37 (67)	0.7
Persistent AF	39 (37)	22 (45)	17 (31)	0.1
Hypertension	65 (63)	32 (65)	33 (60)	0.6
Diabetes	15 (14)	6 (12)	9 (16)	0.6
Body mass index, kg/m^2	23.5 ± 3.1	23.3 ± 3.4	23.7 ± 2.9	0.5
$CHADS_2$ score	1.9 ± 1.2	1.8 ± 1.1	2.0 ± 1.3	0.5
AF burden score	13.7 ± 5.2	13.9 ± 5.5	13.5 ± 4.9	0.7
LV ejection fraction, %	57 ± 10	56 ± 11	59 ± 8	0.1
LA volume index, ml/m^2	65 ± 18	66 ± 18	65 ± 19	0.8
LV mass index, g/m^2	71 ± 16	70 ± 18	72 ± 15	0.4
Laboratory parameters				
eGFR, ml/min/1.73 m^2	64 ± 16	64 ± 17	65 ± 15	0.6
ANP, pg/ml	53 ± 38	71 ± 41	36 ± 30	<0.001
BNP, pg/ml	67 ± 58	85 ± 66	52 ± 44	0.003
hs-CRP, mg/l	1.4 ± 2.2	1.3 ± 2.3	1.5 ± 2.1	0.6

Values are mean ± SD or n (%).

AF = atrial fibrillation; ANP = atrial natriuretic peptide; BNP = B-type natriuretic peptide; eGFR = estimated glomerular filtration rate; hs-CRP = high-sensitivity C-reactive protein; LA = left atrium; LV = left ventricle.

LA REVERSE REMODELING. In the overall study population, the LA volume index decreased significantly from baseline to follow-up (from 65 ± 18 ml/m^2 to 57 ± 19 ml/m^2; $p < 0.001$). On the basis of the cutoff value (≥15% decrease in the LA volume index), 49 patients (47%) were classified as responders, whereas 55 patients (53%) were classified as nonresponders. No significant differences were observed between the responders and nonresponders with respect to the baseline clinical characteristics, LV ejection fraction, and MDCT parameters (Table 1). The prevalence of persistent AF tended to be higher in the responders than in the nonresponders (45% vs. 31%; $p = 0.10$). By definition, the LA volume index decreased significantly in the responders (from 66 ± 18 ml/m^2 to 48 ± 15 ml/m^2; $p < 0.001$), whereas a small increase was observed in the nonresponders (from 65 ± 19 ml/m^2 to 66 ± 20 ml/m^2; $p = 0.20$). Twenty patients (36%) of the nonresponders experienced recurrence of AF during the 6 months after RFCA compared with 9 patients (18%) in the responders ($p = 0.04$).

Pre-procedural serum ANP and BNP levels were significantly higher in the responders than in the nonresponders (Table 1). There was a significant correlation between the percentage decrease in the LA volume index and the pre-procedural serum log ANP (Figure 1A) and log BNP levels (Figure 1B), whereas there was no correlation between the percentage decrease in the LA volume index and the log hs-CRP level (Figure 1C). The serum log ANP, log BNP, and log hs-CRP levels showed different trends during follow-up according to the presence of LA reverse remodeling. During the 6-month follow-up, the serum log ANP, log BNP, and log hs-CRP levels decreased significantly in the responders, whereas no changes in these levels were observed in the nonresponders (Figures 2A to 2C). Among the 49 responders, no significant difference was observed in the pre-procedural ANP levels between patients with and without recurrence of AF during the 6-month follow-up (84.7 ± 42.6 pg/ml vs. 67.5 ± 39.4 pg/ml; $p = 0.30$). A similar result was obtained in nonresponders between patients with and without recurrence of AF (37.3 ± 27.3 pg/ml vs. 35.8 ± 28.4 pg/ml; $p = 0.90$).

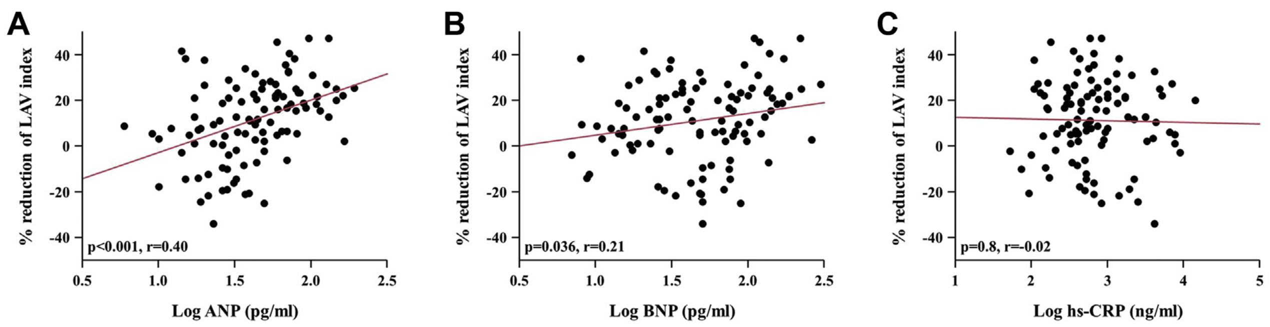
PREDICTORS OF LA REVERSE REMODELING. The results of the univariate and multivariate linear regression analyses for the prediction of LA reverse remodeling are shown in Table 2. In the multivariate analysis, the independent predictors of the percent reduction in the LA volume index after RFCA were the pre-procedural log ANP level (standardized β: 0.48; 95% confidence interval: 12.7 to 41.9; $p < 0.001$) and maintenance of sinus rhythm during follow-up (standardized β: 0.25; 95% confidence interval: 1.5 to 8.4; $p = 0.006$). The multivariate linear regression analysis was repeated, including body mass index and estimated glomerular filtration rate. As a result, similar results were obtained, although p values were slightly changed; log ANP level before RFCA ($p < 0.001$) and maintenance of sinus rhythm during follow-up ($p = 0.009$) were significantly associated with the percent reduction in the LA volume index after RFCA. The results of the receiver-operating characteristic curve analysis for the prediction of reverse remodeling are shown in Figure 3. The best cutoff value of the ANP level was 54 pg/ml (area under the curve = 0.791), providing a sensitivity of 65% and specificity of 85%.

INTEROBSERVER AND INTRAOBSERVER VARIABILITY. The interobserver and intraobserver variability were $r = 0.98$ and $r = 0.97$, respectively, in the LA volume index. According to the Bland-Altman analysis, the 95% limits of agreement for the inter- and intraobserver variability were 1.5 ± 8.3 ml/m^2 and −0.2 ± 7.2 ml/m^2, respectively, in the LA volume index (mean ± 1.96 SD, respectively).

DISCUSSION

In this study, 47% of the patients exhibited LA reverse remodeling after RFCA for AF. In these responders, the serum ANP, BNP, and hs-CRP levels decreased significantly from baseline to follow-up. In contrast, no changes in these laboratory

FIGURE 1 Regression Plots Showing Correlations Between the Percentage Reduction in the LAV Index and Pre-Procedural Serum Levels

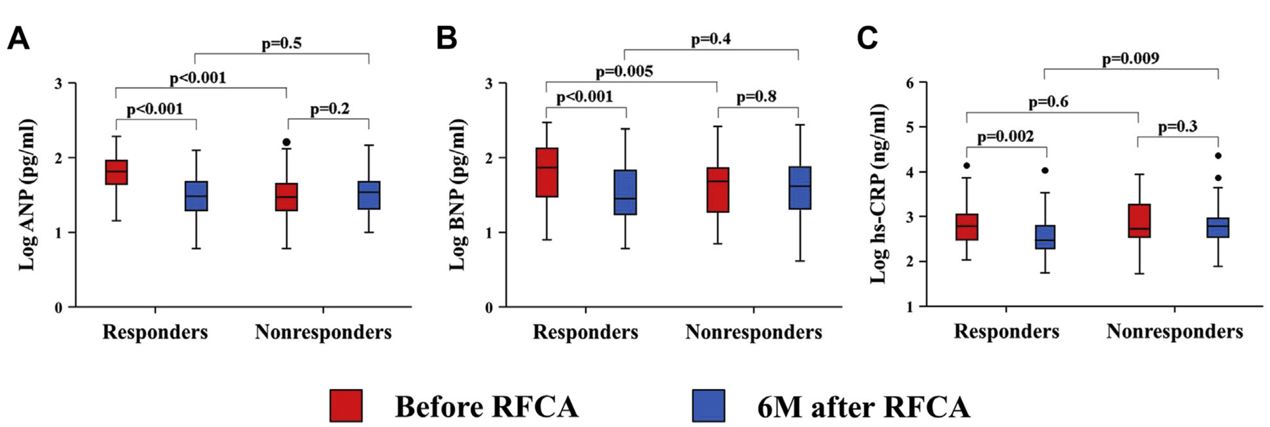


(A) Log atrial natriuretic peptide (ANP), **(B)** log plasma B-type natriuretic peptide (BNP), and **(C)** log high-sensitivity C-reactive protein (hs-CRP). LAV = left atrial volume.

parameters were noted in the nonresponders. The pre-procedural serum ANP level and maintenance of sinus rhythm during follow-up were independent predictors of LA reverse remodeling.

LA REVERSE REMODELING. LA remodeling includes structural, electrical, metabolic, and neurohumoral changes that occur in AF patients, and atrial dilatation is an important aspect of LA structural remodeling (1,2). Interestingly, several studies have demonstrated that this atrial enlargement is, at least partially, reversible (4–6). In addition, reversal of structural remodeling occurs to different degrees in contrast to the uniform reversal of electrical remodeling (7,8). Although the exact underlying pathophysiology of LA reverse remodeling remains unclear, favorable RFCA outcomes have been reported in patients with LA volume reduction (21,22). Beukema et al. (21) reported that among 105 AF patients who underwent RFCA, those who remained in sinus rhythm at 6 months showed a decrease in LA dimension (from 44 to 40 mm), whereas those with recurrence of AF showed an increase in LA dimension (from 45 to 49 mm). Therefore, LA reverse remodeling may become a surrogate marker of success after AF ablation. Furthermore, it was reported that LA reverse remodeling led to subsequent improvement in LA mechanical function (9) and LV systolic and diastolic function (10). Taken together, the prediction of reverse remodeling could allow the efficient selection of suitable candidates who can receive greater benefit from restoration of sinus rhythm by catheter ablation of AF. In contrast, a previous study also demonstrated that reverse remodeling was not observed in approximately 20% of patients with sinus

FIGURE 2 Changes in the Serum Levels Before and After RFCA in Responders and Nonresponders



(A) Log ANP, **(B)** log BNP, and **(C)** and log hs-CRP. RFCA = radiofrequency catheter ablation; other abbreviations as in Figure 1.

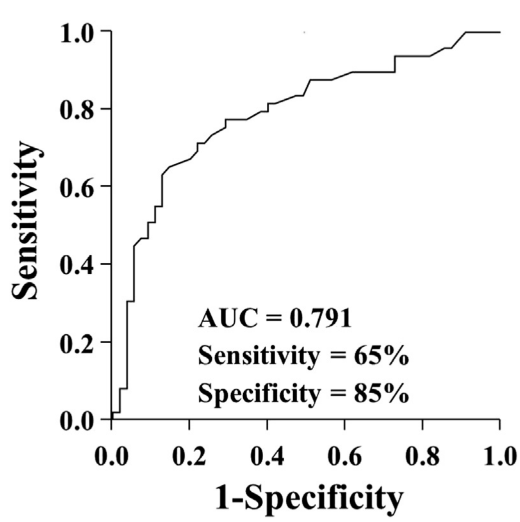
TABLE 2 Univariate and Multivariate Linear Regression Analysis for the Prediction of Reverse Remodeling (% Reduction of LA Volume Index) After RFCA

	Univariate		Multivariate	
	Standardized β (95% CI)	p Value	Standardized β (95% CI)	p Value
Age, yrs	0.10 (−0.21 to 0.62)	0.30		
Female	−0.15 (−6.4 to 0.79)	0.10		
Persistent AF	0.18 (−0.22 to 6.8)	0.07	0.08 (−2.4 to 5.5)	0.40
Hypertension	0.06 (−2.5 to 4.7)	0.50		
Diabetes	−0.02 (−5.4 to 4.5)	0.80		
LV ejection fraction, %	−0.18 (−0.69 to 0.03)	0.07	−0.04 (−0.46 to 0.31)	0.70
LA volume index, ml/m^2	0.10 (−0.10 to 0.29)	0.30		
LV mass index, g/m^2	0.05 (−0.17 to 0.27)	0.60		
Log ANP, pg/ml	0.40 (12.7 to 33.1)	<0.001	0.48 (12.7 to 41.9)	<0.001
Log BNP, pg/ml	0.21 (0.64 to 18.3)	0.036	−0.18 (−20.4 to 3.8)	0.20
Log hs-CRP, ng/ml	−0.02 (−7.6 to 6.1)	0.80		
Maintenance of sinus rhythm	0.26 (1.4 to 8.8)	0.008	0.25 (1.5 to 8.4)	0.006

CI = confidence interval; LA = left atrium; LV = left ventricle; RFCA= radiofrequency catheter ablation; other abbreviations as in Table 1.

rhythm maintenance during 1-year follow-up after RFCA (8). This suggested that sinus rhythm maintenance after RFCA is not enough for reverse remodeling in patients with AF. Yoshida et al. proposed the mechanism of reverse remodeling, which depends on the difference in LA compliance (23). The LA is more compliant and stretched (i.e., elastic), with preserved LA myocytes and less fibrosis, resulting in greater reversibility from structural remodeling. However, the LA is less compliant and stiffer in the remodeled LA, where the myocardium degenerates into fibrous tissue, resulting in less reversibility, which is known as stiff LA syndrome (24,25). Kuppahally et al. (26) also demonstrated less structural remodeling evaluated by pre-procedural delayed enhancement of the LA by magnetic resonance imaging, which predicted favorable LA reverse remodeling after RFCA for AF.

FIGURE 3 Receiver-Operating Characteristic Curve Analysis of the Pre-Procedural Atrial Natriuretic Peptide Level for the Prediction of Reverse Remodeling



AUC = area under the curve.

ANP AND REVERSE REMODELING. ANP is a cardiac hormone mainly synthesized in the atrium that increases in response to volume or pressure overload (11), and elevated serum ANP levels are frequently observed in AF patients (12). Pre-procedural ANP levels were significantly elevated in patients with a higher AF burden compared with those with a lower AF burden in this study. Restoration of sinus rhythm by electrical cardioversion and RFCA significantly decreases the serum ANP level (13,14). Therkelsen et al. showed a significant decrease in the serum ANP level from 197 to 110 pg/ml at 6 months after electrical cardioversion in 60 patients with persistent AF (13). Sacher et al. also reported a decrease in the serum ANP level from 73 to 27 pg/ml at 3 months after RFCA in 43 AF patients (14). In contrast, perpetuation of AF induced myocyte loss and subsequent atrial interstitial fibrosis, resulting in insufficient ANP secretion (15). A previous histopathological study demonstrated an inverse correlation between the serum ANP level and LA collagen volume in AF patients (16). The present study showed that the pre-procedural ANP level was associated with the extent of reverse structural remodeling independent of the AF type, LA volume index, and maintenance of sinus rhythm after RFCA. These observations suggest that reverse structural remodeling is more likely to occur in the elastic LA with preserved LA myocytes and less fibrosis, which can secrete ANP into systemic circulation.

STUDY LIMITATIONS. First, this was a single-center study with a relatively small number of patients. Second, mid-regional pro-ANP was recently developed, and it has been reported to be more stable than mature ANP (27). Mid-regional pro-ANP has so far been shown to offer comparable diagnostic and prognostic performance in patients with heart failure (28), acute coronary syndrome (29), and stroke (30). However, in this study, we measured serum mature ANP levels and did not evaluate mid-regional pro-ANP levels. Third, although recent studies have demonstrated the ability of magnetic resonance imaging as an in vivo technique to quantify LA scarring (31) and have shown that the extent of LA structural remodeling may play an important role in the success of AF ablation (32), we did not perform magnetic resonance imaging. This modality has not yet been considered as the criterion standard, and it is not universally available because current methods to identify atrial scar require specialized software and operator knowledge, experience, techniques, and proper judgment. Finally, contradictory results have been reported with regard to pre-procedural or preoperative ANP levels on recurrence of AF. Pizon et al. have previously shown that higher preoperative ANP levels are associated with successful epicardial AF ablation (33). In other reports (13,34) and our study, pre-procedural ANP was not associated with recurrence of AF after RFCA. This discrepancy may be at least partly explained by differences in the study population (valvular or nonvalvular AF), those with chronic AF, those undergoing another procedure (endocardial or epicardial ablation), and in those followed during the follow-up period. Future studies should be performed to investigate the long-term impact of pre-procedural ANP level on recurrence of AF after RFCA in a large population.

CONCLUSIONS

In the present study, 47% of the patients exhibited LA reverse remodeling after catheter ablation for AF. The serum ANP level at baseline and maintenance of sinus rhythm were independent predictors of LA reverse remodeling.

REPRINT REQUESTS AND CORRESPONDENCE TO: Dr. Koki Nakanishi, Department of Cardiovascular Medicine, Baba Memorial Hospital, 592-8555 Sakai, Japan. E-mail: knakanishi82@gmail.com.

PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: Serum ANP levels before RFCA and maintenance of sinus rhythm during follow-up were independent predictors of LA reverse remodeling. Measurement of ANP levels may have the potential to elucidate pathophysiological mechanisms of LA reverse remodeling after RFCA in patients with AF.

TRANSLATIONAL OUTLOOK: Future studies are needed to investigate the detailed pathophysiological mechanisms of LA reverse remodeling after RFCA and to determine the association between serum ANP levels before RFCA and long-term AF-free outcome.

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