Predictive Capability of Left Atrial Size Measured by CT, TEE, and TTE for Recurrence of Atrial Fibrillation Following Radiofrequency Catheter Ablation

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**Background:** Recurrence of atrial fibrillation (AF) after radiofrequency catheter ablation (RFCA) has been well established and is in part related to left atrial (LA) size. The purpose of this study was to assess the predictive capability of LA diameter (LAD) and LA volume (LAV) by echocardiography and computed tomography (CT) to determine success in patients undergoing RFCA of AF.

**Methods:** Eighty-eight patients with paroxysmal or persistent AF who had undergone RFCA and had a prior transthoracic echocardiogram (TTE), transesophageal echocardiogram (TEE), and CT were enrolled in the study. TTE LADs and LV ejection fraction as well as TEE LADs and LAVs in three views were recorded. CT LAVs were also recorded. Clinical parameters prior to ablation as well as at 1-year follow-up were assessed.

**Results:** A total of 40 (45%) patients with paroxysmal AF and 48 (55%) patients with persistent AF were analyzed. Paroxysmal AF patients had a RFCA success rate of 88% at 1 year with persistent AF patients having a 52% success rate ($P < 0.001$). A CT-derived LAV $\geq$ 117 cc was associated with an odds ratio (OR) for recurrence of 4.8 (95% confidence interval [CI] = [1.4–16.4], $P = 0.01$) while a LAV $\geq$ 130 cc was associated with an OR for recurrence of 22.0 (95% CI = [2.5–191.0], $P = 0.005$) after adjustment for persistent AF.

**Conclusions:** LA dimensions and AF type are highly predictive of AF recurrence following RFCA. LAV by CT has significant predictive benefit over standard LADs in severely enlarged atria even after adjustment for AF type. (PACE 2010; 33:532–540)

**atrial fibrillation, echocardiography, computed tomography, catheter ablation, recurrence, left atrium**

**Introduction**

Atrial fibrillation (AF) continues to be the most common cardiac rhythm disturbance encountered in clinical practice. It is estimated that greater than 2.2 million people in the United States are affected by AF with a prevalence reaching 0.4–1% of the general population.1–3 Hospitalizations for AF have also significantly increased due to the increased prevalence of chronic heart disease, the aging population, and increased detection by ambulatory monitoring.4–6 The clinical consequences range from diminished quality of life and increase in congestive heart failure, to devastating thromboembolic events and increase in mortality.7–10

Treatment of AF has long been achieved with maintenance of sinus rhythm or managing heart rate with pharmacologic agents.2,11 More recently radiofrequency catheter ablation (RFCA) has been offered as an alternative or in conjunction with medical therapy in patients either with refractory AF or with intolerance to antiarrhythmic medications. With improvements in technique and skill, RFCA has provided an important alternative for specific patient populations in whom AF is refractory to antiarrhythmic medications. Despite advances in ablation therapy, AF recurrences are common and the number of patients requiring repeat procedures is not insignificant. AF ablation success has been reported between 68% and 86% at 1 year.12,13 Therefore, predictors of AF ablation success and failure have gained increased attention.

There have been a variety of factors that have been implicated in ablation success ranging from clinical and historical patient data to anatomic features. Left atrial (LA) size has been closely linked with success of pharmacologic interventions as well as RFCA.12,13 The most common measure of LA size has been LA diameter (LAD) measured in a
linear dimension by transthoracic echocardiography (TTE). LAD is often associated with significant inaccuracies given the varying size and shape of the three-dimensional (3D) structure in this population.\(^{15}\) LAV measurements have been further studied and found to provide improved accuracy of LA size.\(^{16,17}\)

In this study we evaluated both LAD by TTE and transesophageal echocardiography (TEE) and LA volume (LAV) by both TEE and computed tomography (CT) in patients undergoing RFCA for AF. Specifically, we evaluated the association of various measures of LA size with success of AF ablation.

**Methods**

**Study Population**

Four hundred and eighty-three consecutive patients with recurrent paroxysmal or persistent AF who underwent RFCA of AF at our institution were screened. Of this initial population, 88 patients met criteria of having a TTE, TEE, and CT measuring the LAV and these patients were subsequently analyzed. The age range of all patients spanned 30–78 years of age with a mean of 57 ± 16 years. There were 65 males and 23 females.

All patients had an initial TTE with an LAD within 1 month prior to initial referral. Patients subsequently had a TEE and CT of the left atrium and pulmonary veins to define anatomy all performed at a single center. All patients subsequently underwent RFCA by circumferential pulmonary vein isolation with or without additional linear lesions at the discretion of the operator. Patients were seen in follow-up for at least 1 year after the initial ablation procedure. All clinical information was obtained by a chart review of medical records. Paroxysmal AF was defined as AF that was self-terminating with duration of not more than 7 days. Persistent AF was defined as AF that was not self-terminating requiring electrical or chemical cardioversion or AF that persisted for greater than 7 days. Among the 88 patients, 40 had paroxysmal AF and 48 had persistent AF.

**Echocardiography**

A TTE was performed within 1–2 months prior to the AF catheter ablation procedure and the end-systolic LAD was measured in the parasternal long-axis view according to American Society of Echocardiography (ASE) guidelines.\(^{18}\) A TEE was performed within 1–2 days prior to catheter ablation using a multiplane probe. The LAV and LAD were measured in the standard four-, two-, and three-chamber views (roughly 0–30°, 60–90°, and 120–150° on the multiplane probe, respectively). The end-systolic LAV was measured in each view using the modified Simpson’s rule, and the LAD was measured about 1 cm above the mitral annulus in the two- and four-chamber views. In the three-chamber view, the end-systolic LAD was measured between the posterior aortic root and posterior LA wall in a manner similar to the transthoracic measurement. All diameters and volumes were reported as both absolute values and indexed to body surface area (BSA) and were analyzed as a mean of the three measured views as well as analyzed individually in a single dimension. The LA appendage was excluded in all measurements. All transesophageal measurements were made by two independent readers to allow for interobserver variability analysis. All readers were blinded to procedure outcomes as well as patient characteristics.

**Computed Tomography**

Contrast-enhanced cardiac CT scans were performed within 24–48 hours of AF ablation using a 64-slice CT scanner (Brilliance, Philips Medical Systems, Andover, MA, USA). Approximately 125 cc of a contrast agent (Optiray 350, Coviden/Mallinckrodt Medical Inc, St. Louis, MO, USA) was injected with a 50 cc normal saline flush prior to image acquisition. Scan duration time was approximately 5–10 seconds and images were obtained on one breath-hold at end-inspiration and expiration.

The LAV was measured from off-line analysis and area determined on 1–2-mm slices. The entire LA was filled then with virtual dye and a 3D model excluding the pulmonary veins and the LA appendage was constructed. The atrial volume was then calculated using this model. A straight line was drawn between the bases of the mitral valve leaflets and was used as a border of the LA outlet. All measurements were obtained in a blinded fashion to patient characteristics and AF ablation outcome.

**RFCA Procedure**

Pulmonary vein isolation was performed in all patients using wide area circumferential applications of radiofrequency energy and verified with a circular mapping catheter (Lasso Catheter, Biosense Webster, Inc, Diamond Bar, CA, USA). Additional linear ablation lesions along the LA roof and/or mitral isthmus were completed at the operator’s discretion. In some patients, complex fractionated electrograms were also targeted within the left atrium and coronary sinus. The ablation catheter used initially was an 8-mm nonirrigated tip (Navistar, Biosense Webster). When the 3.5-mm irrigated tip catheter (Navistar Thermocool, Biosense Webster) became available, the remainder of the patient procedures were performed.

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with this catheter. A power and temperature limit of 60 W and 60°C was used for the nonirrigated tip catheter. A power limit of ≤35 W with a tip temperature of ≤40°C was used for the irrigated tip catheter.

**Follow-up and Definition of Recurrence**

All patients were initially followed up at 3, 6, and 12 months. After the first year, they were followed at 3–6-month intervals. Electrocardiograms (ECGs) were performed at each follow-up visit. Twenty-four- or 48-hour Holter monitoring was performed for any patient who reported recurrent symptoms of AF. Patients were evaluated for the presence of normal sinus rhythm and absence of recurrent symptoms. All patients with symptoms were subsequently evaluated with Holter and Event monitoring to document AF recurrence. Any documented AF recurrence was deemed a failure.

**Statistical Analysis**

All continuous variables were tested for normality using histogram plots and the Shapiro-Wilk test and only AF duration was found to deviate significantly from a normal distribution. Thus, continuous variables are described as mean (±standard deviation) and differences between groups were tested using a $t$-test or the Wilcoxon rank-sum test where appropriate. Categorical variables are reported as a number (%), and differences between groups were tested using chi-square tests or Fisher’s Exact test where appropriate. The diagnostic ability of each of the parameters were examined using a receiver operator characteristic (ROC) curve and the difference between the ROC estimates were tested using a nonparametric approach as described by DeLong et al.\(^7\) Logistic regression was used to analyze the strength of each imaging parameter for predicting recurrence of AF. Since no cutoffs have been specified in earlier studies, we divided the variables into quartiles and used the upper quartile as high-risk parameters in the risk models. A significance level of $P < 0.05$ was considered significant. All statistical analyses were performed using SAS 9.1.3 for Windows (SAS Institute, Cary, NC, USA).

**Results**

**Patient Characteristics**

The studied patient population included a total of 88 patients with paroxysmal or persistent symptomatic AF who subsequently underwent RFCA. The baseline characteristics are summarized in Table I and categorized by recurrence of AF after ablation and by AF classification. Clinical characteristics of patients with and without recurrence of AF were generally similar and there were no significant differences in the medical history as well as drug treatment. Overall there were 65 (74%) male patients. Paroxysmal AF was present in 40 (45%) patients and the remaining 48 (55%) had persistent AF. The mean age in each group was also similar. The time duration from initial AF symptoms to ablation was not significantly different, but the persistence of the arrhythmia was significantly related to the recurrence rate. Overall, the groups of paroxysmal and persistent AF patients had comparable baseline characteristics except for a slightly higher frequency of valve surgery and angiotensin-converting enzyme inhibitor treatment in the persistent AF group.

** Procedure Outcome**

Among the 40 paroxysmal AF patients, 18 patients needed a second ablation and of these, two needed a third ablation within 1 year with a mean procedure rate at 1 year of 1.50. Paroxysmal AF patients had a RFCA success rate of 88%. Of the 48 persistent AF patients, 24 patients needed a second ablation and of these, three needed a third ablation by 1 year with a mean procedure rate of 1.56. These persistent AF patients had a RFCA success rate of only 52%.

**LA Dimensions and Recurrence of AF**

The results from the echocardiogram and CT recordings are shown in Table II. The atrial diameter and volume measured by echo or CT was enlarged markedly in the group of patients with recurrence of AF after ablation. Since the atrial dimensions had such a large influence on the success rate of AF ablation, we determined the diagnostic value of each of the imaging parameters in distinguishing patients with future recurrence from patients without recurrence using ROC analysis (see Fig. 1).

The results of both univariate and multivariate logistic regressions models (adjusted for persistent AF) using upper quartiles as cutoffs are shown in Table III. It was clear that persistent AF was a very strong predictor of AF recurrence after AF ablation with an odds ratio (OR) of 6.4 ($P < 0.001$). Although the upper quartile for each modality adjusted for persistent AF was associated with a higher risk of AF recurrence, only LAV measured by CT (OR 4.8, $P = 0.01$) and LAD measured as the mean of three views by TEE (OR 3.5, $P = 0.03$) remained significantly predictive for AF recurrence.

Across all modalities the recurrence rate of AF after ablation increases in a fairly linear fashion based on increasing atrial size. However, when measuring LAV by CT, there appears to be an
Table I.
Baseline Characteristics of the Study Population Shown by Recurrence of AF after Ablation and by AF Classification

| No AF Recurrence | AF Recurrence | Paroxysmal AF | Persistent AF |
|------------------|---------------|---------------|---------------|
| N                | 60            | 28            | 40            | 48            |
| Demographics     |               |               |               |               |
| Age              | 57.2 ± 10.3   | 57.93 ± 10.6  | 55.3 ± 11.2   | 59.2 ± 9.3    |
| Male (%)         | 44 (73)       | 21 (75)       | 29 (73)       | 36 (75)       |
| Medical History  |               |               |               |               |
| Hypertension     | 35 (58)       | 18 (64)       | 22 (55)       | 31 (65)       |
| Coronary artery disease | 6 (10) | 3 (11) | 5 (13) | 4 (8) |
| Diabetes mellitus | 3 (5) | 4 (14) | 3 (8) | 4 (8) |
| PVD              | 1 (2)         | 2 (7)         | 1 (3)         | 2 (4)         |
| Hyperlipidemia   | 25 (42)       | 14 (50)       | 18 (45)       | 21 (44)       |
| Coronary bypass surgery | 2 (3) | 3 (11) | 2 (5) | 3 (6) |
| Valve surgery    | 1 (2)         | 4 (14)        | 0 (0)         | 5 (10)        |
| Medications      |               |               |               |               |
| β-blocker        | 50 (83)       | 26 (93)       | 32 (80)       | 44 (92)       |
| ACE-I/ARB        | 25 (42)       | 16 (57)       | 13 (33)       | 28 (58)*      |
| Statins          | 22 (37)       | 14 (50)       | 17 (43)       | 19 (40)       |
| Warfarin         | 52 (87)       | 27 (96)       | 35 (88)       | 44 (92)       |
| Antiarrhythmic drugs | 58 (97) | 27 (96) | 38 (95) | 47 (98) |
| AF Characteristics|             |               |               |               |
| Paroxysmal       | 35 (58)       | 5 (18)*       | –            | –            |
| Persistent       | 25 (42)       | 23 (82)*      | –            | –            |
| Success          | –             | –             | 35 (88)      | 25 (52)      |
| Recurrence       | –             | –             | 5 (12)       | 23 (48)*     |
| AF Duration (months) | 47.2 ± 31.9 | 53.9 ± 34.8  | 47.1 ± 31.7  | 52.1 ± 34.4  |
| Echo Characteristics|          |               |               |               |
| Initial EF on referral | 55.8 ± 7.0   | 52.5 ± 10.9   | 57.6 ± 3.6   | 52.3 ± 10.5   |
| Initial LAD on referral | 4.32 ± 0.43  | 4.79 ± 0.54   | 4.19 ± 0.33  | 4.71 ± 0.52   |

* Differences between populations at P < 0.05. Categorical variables are shown as numbers (%) and continuous variables as mean ± standard deviation.
Abbreviations: PVD = peripheral vascular disease; AF = atrial fibrillation; ACE = angiotensin-converting enzyme; ARB = angiotensin receptor blocker; EF = ejection fraction; LAD = left atrial diameter.

Table II.
Results from Echocardiographic and CT Imaging

| Parameter         | AF Recurrence (n = 28) | No AF Recurrence (n = 60) | P     | Paroxysmal AF (n = 40) | Persistent AF (n = 48) | P     |
|-------------------|------------------------|---------------------------|-------|------------------------|------------------------|-------|
| Ejection fraction (TTE) (%) | 52.5 (±10.9) | 55.8 (±7.0) | 0.09  | 57.6 (±3.6) | 52.3 (±10.5) | 0.003 |
| LAD (TTE) (cm)    | 4.8 (±0.54)           | 4.3 (±0.43)               | <0.001| 4.2 (±0.33)           | 4.7 (±0.52)            | <0.001|
| LAD 1 view (TEE) (cm) | 4.6 (±0.49) | 4.2 (±0.57) | <0.001| 4 (±0.52)             | 4.6 (±0.49)            | <0.001|
| LAD, 3 views (TEE) (cm) | 4.9 (±0.55) | 4.4 (±0.47) | <0.001| 4.2 (±0.38)           | 4.8 (±0.52)            | <0.001|
| LAV, 2 views (TEE) (cc) | 102 (±41.6) | 74.2 (±26.8) | <0.001| 65.3 (±20.2)          | 97.7 (±37.1)           | <0.001|
| LAV, CT (cc)      | 123 (±41.2)           | 86.2 (±25.2)              | <0.001| 76.6 (±18.6)          | 115 (±36.9)            | <0.001|

Abbreviations: TTE = transthoracic echocardiogram; TEE = transesophageal echocardiogram; LAD = left atrial diameter; LAV = left atrial volume; CT = computed tomographic.
inflection point at 130 cc (Fig. 2) above which there is a more dramatic increase in AF recurrence. A LAV of >130 cc by CT was associated with an OR of 22.0 (95% confidence interval [CI] = [2.5–191.0], P = 0.005) after adjustment for persistent AF. The failure rate in patients with a volume above this threshold was greater than 90%.

We also tested the difference between the most commonly used parameter of LA size, the LAD obtained from the parasternal window by TTE, and LAV measured by CT. The correlation between the two parameters was poor (r = 0.55, see Fig. 3A). The correlation increased markedly when LAD was measured using TEE (r = 0.75, see Fig. 3B).

LA size was also categorized by the ASE classification recommendations of normal, mildly enlarged, moderately enlarged, and severely enlarged20 (Fig. 4). LAV measured by CT categorizes substantially more patients in the severely enlarged group (68%) than did LAD by TTE and TEE (16% and 13%, respectively), (Fig. 4A). With regard to predicting AF recurrence, the highest rate of AF recurrence occurred in the severely enlarged category of LAV when measured by CT (Fig. 4B). However, LAD by TTE and TEE showed elevated

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Table III.

Results from Logistic Regression Analysis

|                        | Unadjusted | Adjusted for Persistent AF |
|------------------------|------------|----------------------------|
|                        | OR         | 95% CI    | P  | OR   | 95% CI    | P  |
| Persistent AF          | 6.4        | 2.2–19.2  | 0.001 | –       | –       | –   |
| LA volume ≥ 117 cc, CT (upper quartile) | 8.7        | 3.0–25.8  | <0.001 | 4.8   | 1.4–16.4  | 0.01 |
| LA volume ≥ 99 cc, mean of 2 views TEE (upper quartile) | 3.8        | 1.4–10.3  | <0.01 | 2.0   | 0.7–6.0   | 0.22 |
| LA diameter ≥ 4.9, mean of 3 views TEE (upper quartile) | 6.5        | 2.3–18.6  | <0.001 | 3.5   | 1.1–11.2  | 0.03 |
| LA diameter ≥ 4.7, 1 view TEE (upper quartile) | 3.2        | 1.2–9.0   | 0.02  | 1.9   | 0.6–5.7   | 0.26 |
| LA diameter ≥ 4.8, standard PLAX view TEE (upper quartile) | 5.0        | 1.8–13.7  | 0.002 | 2.7   | 0.9–8.2   | 0.07 |
| LA linear lesions during RFCA | 2.3        | 0.9–5.8   | 0.090 | 1.3   | 0.5–3.8   | 0.31 |

Abbreviations: LA = left atrial; CT = computed tomography; TEE = transesophageal echocardiogram; RFCA = radiofrequency catheter ablation.
AF recurrence rates in both the moderately and severely enlarged categories.

When the results of the imaging tests were indexed for BSA, the area under curve (AUC) generally decreased, but the order of the imaging methods remained unchanged. Thus, only the nonindexed results are presented here.

**Effect of Linear Ablations and Recurrence of AF**

Overall 48 of 88 patients received linear ablation lesions at the discretion of the operator during RFCA. Of these patients, 45 had a LA roof line performed and three of these patients had both a roof and mitral isthmus line. Bidirectional conduction block was evaluated for and achieved with all linear lesions. Only 14 of the 40 paroxysmal AF patients received linear lesions while 34 of the 48 persistent AF patients received linear lesions. With regard to outcome, 60.4% of patients with additional linear lesions had freedom from AF recurrence compared to 77.5% of patients without linear lesions. Results from logistic regression demonstrated an unadjusted OR for recurrence of 2.3 that fell to 1.3 after adjusting for AF type (Table III), neither of which was statistically significant.

**Discussion**

The goal of this study was to evaluate the predictive capability of LA dimensions among various imaging modalities in determining success of RFCA for AF. We were able to demonstrate the relationship of both LAD and LAV and the rate of success of AF ablation. The rate of recurrence of AF at 1 year was 32%. The rate of recurrence in the persistent AF group was 48% as opposed to only 12% in the paroxysmal group. Aside from AF type, LAV as measured by CT was a significant predictor of AF recurrence.

There have been various studies attempting to address this relationship of LA size and AF ablation success. Early data have demonstrated a relationship between increasing LA size and AF recurrence after AF ablation. Most of these initial studies have mainly correlated LAD by M-mode measurements with ablation success rates. Shin et al. showed that LAV measured by biplane two-dimensional (2D) echocardiography are even more predictive of success. Two recent studies utilized CT measurements of LAV and have shown a strong correlation with AF ablation success and increasing size. Despite increasing data, it is still unclear if there is incremental benefit of one measurement over another. Specifically, is there benefit of obtaining a TEE and/or CT after an initial TTE to better predict outcomes?

Our study appears to be the first to evaluate LA dimensions by multiple modalities in patients undergoing AF ablation. LAD by TEE had an incremental benefit over LAD by TTE (P = 0.053). LAV by CT had a significant benefit over traditional TTE LAD (P = 0.015). As expected, TTE LA dimensions had a poor correlation with CT volumes. The incremental predictive power of LAV over LAD and CT over echocardiography can be explained by several reasons. First, the inherent
Figure 3. Correlation between LAD by echocardiography and LAV by CT. (A) Correlation between LA diameter measured by TTE and LAV measured by CT. The correlation between the two parameters was relatively low ($r = 0.55$). As shown in the plot, the discrepancy between the two modalities increases at left atrial volumes above 120 cc. (B) Correlation between LA diameter measured from three views by TEE and LAV measured by CT. Using the mean of three views to measure LA diameter with TEE increased the correlation between LAD and LAV by CT ($r = 0.75$). Also the discrepancy is decreased at larger atrial volumes.

inaccuracies of a one-dimensional measurement of LA size have been well described. LA size can be significantly under appreciated with this technique, and rarely does LA enlargement occur in a single dimension. We used TEE to measure LAV as opposed to transthoracic imaging. Given the position of the left atrium in the near-field, it was easier to define endocardial borders and make 2D measurements. However, the posterior wall of the left atrium was often difficult to define and likely still undersized our LAV measurements. The advantage of CT stemmed from the ability to visualize the entire chamber in 3D with reliable and reproducible imaging. There were no limitations from poor acoustic windows with this method.

We further analyzed the effects of additional linear lesions performed during catheter ablation. As expected, a greater percentage of persistent AF patients received additional ablation lines when compared to paroxysmal AF patients. While one can postulate that additional lesions might affect procedure outcome, in our study it appeared that additional ablation lines were used by operator discretion when dealing with a more difficult baseline population. In our population, linear lesions were more likely associated with patients with higher AF recurrence rather than being causal.

There are several limitations of this study that should be addressed. Although all TEE and CT measurements were performed at a single institution and reanalyzed by the authors, the TTE LAD measurements were obtained from the initial referral echocardiogram performed by the patient’s primary cardiologist. Our goal was to mimic clinical practice in electrophysiology referral centers. While most of these TTEs were performed at our institution, some were from satellite clinics and outlying hospitals and therefore interobserver variability analysis could not be performed. TEEs and CTs were performed within 48 hours of the subsequent ablation while TTEs were performed within the preceding month. Although the likelihood of a significant change in LA size within this time period is low given that all patients had significant baseline AF without change in clinical status or hemodynamics, it is conceivable that both the time delay and/or difference in rhythm at the time of the study (sinus rhythm vs AF) had some impact in chamber size. Our search for AF in follow-up included ECGs at every 3-month visit along with Holter/Event monitoring for any patient with symptoms. Further home monitoring for asymptomatic patients in sinus rhythm was left to the discretion of their primary cardiologist. While the threshold for ordering home monitoring was low, and was received by the majority of patients, it is possible that certain asymptomatic patients with short paroxysms of AF post ablation were missed. Although technically this would represent a recurrence, clinically these patients had significant improvement overall. Finally, the data obtained are from a single center analysis and their general applicability may be supported on a larger scale with a multicenter study.
Given these results, it is reasonable to question whether there is a LA size over which AF is not curable. Given the risks associated with AF ablation, one must consider the risk/benefit ratio and likelihood of success. LAD > 4.9 cm by TEE and LAV > 117 cc by CT had >30% rate of recurrence. Although an acceptable failure rate is difficult to generalize and is often dependent on individual circumstances and past history, the failure rate of >90% with an OR of 22 seen in patients with CT LAV over 130 cc is excessive and would likely be considered unfavorable by most physicians.

**Conclusion**

LA dimensions are highly predictive for AF recurrence independent of AF type in patients undergoing ablation for AF. Significant predictive value is obtained by measuring LAV by CT or LAD from TEE compared to the conventional measurement of LAD obtained from the parasternal view during TTE. Of the two, CT volumes appear to be...
slightly better. It appears that a threshold value exists for an atrial volume over which the recurrence rate of AF after ablation is extremely high. In our study, while a LAV of 117 cc or larger, as measured by CT, was significantly predictive of AF recurrence, a volume of 130 cc or larger was associated with a recurrence rate of AF after ablation of more than 90%. Given the significant rate of recurrence at this size, the risk of undergoing catheter ablation far outweighs any clinical benefit.

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