Imaging modalities for measurements of left atrial volume in patients with atrial fibrillation: what do we choose?

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This editorial refers to ‘Measurement of left atrial volume in patients undergoing ablation for atrial fibrillation: comparison of angiography and electro-anatomic (CARTO) mapping with real-time three-dimensional echocardiography’ by H. Müller et al., on page 792.

The relationship between atrial enlargement and atrial fibrillation (AF) has been established by numerous studies, providing evidence that atrial dilatation may be either a cause or consequence of AF.1,2 Ever since the discovery that ablative therapy targeting ectopic beats originating from the pulmonary veins may eliminate AF,3 the evaluation of left atrial anatomy and assessment of its volume has become a topic of major interest. Concomitantly with the evolvement of percutaneous ablative therapy for AF, technological progress resulted in development of different imaging modalities enabling accurate depiction of the pulmonary veins and surrounding atrial structures. These imaging techniques, including conventional left atrial angiography,4 transthoracic echocardiography, three-dimensional intracardiac echocardiography,5 contrast-enhanced computed tomography, and cardiovascular magnetic resonance imaging (MRI),6,7 have all shown to be useful for the assessment of left atrial volume.

Atrial imaging techniques

The most frequently applied non-invasive method for assessment of left atrial volume in daily clinical practice is transthoracic echocardiography.5 There are different echocardiographic methods to calculate left atrial volume but they are all based on geometric assumptions. These measurements are highly variable and operator-dependent. Therefore, transthoracic echocardiography is not an attractive imaging modality for repetitive measurement of left atrial volume. Recently introduced real-time three-dimensional echocardiography is more accurate as it uses semi-automatic calculations resulting in a higher reproducibility.5

At present, MRI is regarded as the gold standard for the measurement of left atrial volume.5 Both MRI and multislice computed tomography can be used to accurately measure atrial volume due to the three-dimensional reconstructions acquired with high spatial and temporal resolutions. However, acquisition of MRI images is time-consuming and the use of multislice computed tomography requires contrast agents and high radiation exposure.5 Both techniques require a regular rhythm for optimal image quality, which may limit the application in patients with AF.

Clinical relevance of atrial enlargement

Atrial enlargement is associated with adverse outcome, including stroke, heart failure, and mortality.2 Left atrial size in patients with AF is an independent predictor of AF recurrence after circumferential pulmonary vein ablation.8 Previous studies have shown that when sinus rhythm is restored, either by electrical cardioversion or by catheter ablation, left atrial size decreases due to left atrial reverse remodelling.2 Also, when AF recurred after ablative therapy, it was associated with left atrial dilatation.9 Thus, the quantification of left atrial volume in patients with AF undergoing ablative therapy is not only important at the initial evaluation prior to catheter ablation procedure but also during follow-up.

The importance of investigating the accuracy of different imaging modalities for the determination of left atrium volume was evaluated by Müller et al.10 in this study. In 127 patients undergoing radiofrequency catheter ablation of AF, left atrial volumes calculated with non-invasive and invasive imaging techniques were compared. Prior to ablation, left atrial volume was determined invasively by left atrial angiography and three-dimensional electro-anatomical mapping. These results were compared with...
transthoracic real-time three-dimensional echocardiographic examinations. So far, this is the first study comparing these invasive and non-invasive imaging techniques. Of interest, left atrial volume assessed by invasive techniques was larger than as determined by transthoracic real-time three-dimensional echocardiography and should therefore not be used as baseline values (due to the impossibility to use angiography during follow-up). From their study data, the authors furthermore concluded that invasively obtained left atrial volume should not be used as a baseline value for a non-invasive follow-up study using transthoracic real-time three-dimensional echocardiography.

As discussed above, the findings of this study are of clinical relevance.

The assessment of left atrial volume—and function—is of paramount importance in a variety of clinical settings. For example, reduced ventricular compliance in patients with valvular heart disease may cause a rise in intra-atrial pressure. In turn, this will result in atrial stretch and subsequently atrial dilation. Hence, atrial enlargement is an indicator of the degree of diastolic dysfunction. The management of these patients can be guided by monitoring alterations in left atrial size over time. An accurate and reproducible imaging technique is therefore essential. In the era where imaging modalities are rapidly evolving, a stepwise evaluation of the available imaging techniques is mandatory. The outcome of the study performed by Müller et al.\(^\text{10}\) is therefore an important contribution to daily clinical practice. Three-dimensional echocardiography seems to be a reliable modality to study left atrial volumes and can be use sequentially.

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**References**