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CLINICAL RESEARCH

Echocardiographic measurement of left atrial volume: Does the method matter?

Importance du choix de la méthode de mesure du volume de l'oreillette gauche sur l'appréciation du degré de dilatation

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KEYWORDS
Left atrial volume;
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Summary
Background. — Four two-dimensional echocardiographic methods (cube, ellipsoid, Simpson's and area-length) can be used to assess left atrial volume (LAV).
Aims. — To compare absolute LAV measurements and evaluate agreement regarding the semi-quantitative assessment of degree of left atrial (LA) enlargement, between methods.
Methods. — We prospectively measured LAV in 51 healthy volunteers using the four methods, and defined thresholds for moderate (mean + 2 standard deviations [SDs]) and severe (mean + 4 SDs) LA enlargement for each method. In 372 patients referred for echocardiography, we compared absolute LAV measurements and agreement between methods.
Results. — LAV was significantly different between methods in the healthy volunteer group (11 ± 4, 17 ± 3, 26 ± 6 and 28 ± 7 mL/m^2, respectively; $P < 0.0001$), resulting in different thresholds for moderate and severe LA enlargement. LAV was also significantly different in the 372 patients (30 ± 20, 47 ± 27, 61 ± 34 and 65 ± 36 mL/m^2, respectively; $P < 0.0001$). Agreement regarding degree of LA enlargement (none, moderate, severe), using the area-length method as reference, was modest with the cube method (kappa = 0.41), correct with the ellipsoid method (kappa = 0.60) and excellent with Simpson's method (kappa = 0.83).

Abbreviations: A/L, area-length; BSA, body surface area; LA, left atrial/atrium; LAV, left atrial volume; LAVI, left atrial volume index.

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Conclusion. — The choice of the method had a major effect on assessment of degree of LA enlargement. Our results suggest that the cube and ellipsoid methods, which significantly underestimated LAV and provided modest agreement, should be disregarded. In contrast, Simpson's method and the area-length method were slightly different, but showed close agreement, and should be preferred, using dedicated thresholds (50 and 56 mL/m^2 respectively).

MOTS CLÉS
Volume ;
Oreillette gauche ;
Échocardiographie ;
Valeurs seuil

Résumé
Contexte. — Il existe quatre méthodes de mesure de l'oreillette gauche (OG) en échocardiographie transthoracique (cube, ellipse, Simpson's, aire/longueur).
Objectif. — Évaluer l'impact du choix de la méthode de mesure du volume de l'OG en échocardiographie sur l'estimation de son degré de dilatation.
Méthodes. — Nous avons calculé prospectivement le volume de l'OG avec chaque méthode chez 51 sujets sains, ainsi que les valeurs seuil permettant de définir une OG dilatée (moyenne + 2DS), et très dilatée (moyenne + 4DS). Nous avons comparé dans une cohorte de 372 patients les valeurs absolues de volume de l'OG et la concordance des quatre méthodes de mesure.
Résultats. — Le volume OG était différent selon la méthode utilisée (11 ± 4, 17 ± 3, 26 ± 6 et 28 ± 7 mL/m^2, respectivement ; $p < 0{,}0001$), avec en conséquence des valeurs seuil différentes pour définir une dilatation modérée ou sévère. Le volume OG était également différent pour les patients (30 ± 20, 47 ± 27, 61 ± 34 et 65 ± 36 mL/m^2, respectivement ; $p < 0{,}0001$). La concordance pour définir le degré de dilatation OG (nulle, modérée, sévère) entre la méthode aire/longueur et la méthode du cube était modeste (kappa = 0,41), correcte avec la méthode de l'ellipse (kappa = 0,60) et excellente avec la méthode du Simpson (kappa = 0,83).
Conclusion. — Le choix de la méthode influence fortement l'appréciation du degré de dilatation de l'OG. Les méthodes aire/longueur et Simpson, contrairement à celle du cube et de l'ellipse, donnaient des volumes peu différents et une excellente concordance. Elles devraient être privilégiées dans l'évaluation de la dilatation OG en utilisant des seuils dédiés (50 et 56 mL/m^2 respectivement).

Background

Left atrial (LA) size is an important prognostic marker in various cardiovascular diseases, such as valvular heart disease, hypertension, dilated cardiomyopathy, hypertrophic cardiomyopathy and stroke [1—11]. Transthoracic echocardiography is the most widely used method available to assess LA size, and the superiority of LA volume (LAV) over LA diameter is now well established [4,7,12—14]. Thus, LAV should be measured consistently during each echocardiogram. However, LAV can be calculated using different methods. The most accurate method remains a matter of debate, and the effect of the method on the assessment of the degree of LA enlargement has never been evaluated.

Thus, in this prospective study, we aimed: to compare LAV measurements between four methods (the cube method, the ellipsoid method, the biplane Simpson's method and the biplane area-length [A/L] method) to define specific thresholds for moderate and severe LA enlargement for each method, in a healthy volunteer group; and to evaluate the agreement between methods regarding the semiquantitative evaluation of the degree of LA enlargement, in a subset of patients referred for clinically indicated transthoracic echocardiography.

Methods

Population

We prospectively enrolled two different groups of participants: healthy volunteers with no history of cardiovascular disease (nurses, physicians and medical students enrolled in an ongoing prospective study [GENERAC, clinicalTrial.gov number NCT00647088]); and consecutive patients who underwent transthoracic echocardiography between January and December 2010 conducted by the last author (D.M.-Z.) using an IE33 ultrasound system (Philips, Amsterdam, Netherlands). Exclusion criteria were a poor echocardiographic window or incomplete data for the measurement of LAV by the four methods. All participants gave informed consent.

Clinical data

For each volunteer or patient, weight, high, body surface area (BSA), medical history and indication for echocardiography were collected. BSA was calculated as $2 \times \sqrt{}$([weight