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**Assessment of the role of tgf-beta and 3D echocardiographic evaluation in the early diagnosis of atrial remodelling in elite athletes**

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**Background:** Long-standing vigorous exercise may be associated with atrial structural remodelling. This remodelling process may be the cause of increased frequency of atrial arrythmias in athletes. Early diagnosis of atrial remodelling by atrial imaging has a key role in management of atrial arrythmias in elite athletes.
**Purpose:** We aimed to detect early phases of atrial remodelling in elite athletes by 3D echo and serum markers of fibrosis.
**Methods:** In this study, we enrolled weigth lifters (n=33), marathoners (n=32), sedantary participants (n=30) and patients who recieved cardiotoxic chemotheraphy (n=10). Serum TGF-beta levels were measured. Both left atrial (LA) 3D volume and strain values were analysed.
**Results:** There was a positive correlation between serum TGF-beta levels and LA volumes and negative correlation between TGF-beta levels and strain values. TGF-beta levels were higher among chemotheraphy and weight lifter groups, compared to control and marathoner groups [mean 0,57±0,3 and0,55±0,2 vs 0,45±0,2 and0,47±0,2, respectively, p=0.005]. LA volumes were higher among chemotheraphy and weight lifter groups [median 33 (26–38) and31 (23–36) respectiely, p=0,005], and strain values were lower in these two groups [mean 20,3±2,5 and 24,6±4,5, respectively, p<0,005] compared to control and marathoner groups (Table 1). Total exercise volume was higher in weight lifter group than marathoners (p=0,001). There wasn't any differance between all groups regarding left vetricular systolic and diastolic functions.

Table 1. Left Atrial 3D Strain and Volume Results

| Variables | Control Group (n=32) | Marathoners (n=33) | Weight Lifters (n=32) | Chemoterapy Group (n=10) |
|---|---|---|---|---|
| LAEF % | 64±4,4 | 62,5±6,0 | 59,7±4,0 | 56,3±4,7* |
| maxLAVI (ml/m$^2$) | 28 (21–32) | 29 (23–36) | 31 (23–36)* | 33 (26–38)*† |
| minLAVI (ml/m$^2$) | 12 (7–19) | 13 (6–21) | 16 (8–27)*† | 16 (13–21)*† |
| LSpos % | 19,06±3,3 | 19,4±4,5 | 16,2±3,6*† | 12,5±1,7*† |
| LSneg % | -9,3±1,7 | -9,2±1,7 | -8,1±1,3 | -7,7±0,8*† |
| LStot % | 28,6±4,9 | 28,0±5,9 | 24,6±4,5*† | 20,3±2,5*† |

LAEF: Left atrial ejection fraction, minLAVI: minimum left atrial volume index, maxLAVI: maximum left atrial volume indes, LSpos: positive longitudunal strain, LSneg: negative longitudinal strain, LStot: total longitudinal strain. *p values <0,05 in comparison with control group, †p values <0,05 in comparison with marathoners.

**Conclusions:** This study demonstrates that TGF beta levels and left atrial strain and volume measurements performed by 3D echocardiography can predict early atrial remodelling in elite athletes. Atrial function is impaired with increasing total exercise volume and more strenous exercise.

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**A preliminary methodology study of producing 3D printing left heart model by multimodal medical image fusion technology**

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**Background:** 3D printing heart always chose the CTA as data source, but can not accurately reflec the heart valve anatomy.
**Purpose:** This study aimed to fuse the ultrasonic valve images and CT images, obtain 3D printing heart with abundant anatomical information and new methods of image processing.
**Methods:** We retrospectively analyzed 13 patients with atrial fibrillation and no structural cardiac diseases under cardiac examinations of 3D-TEE and CTA to obtain DICOM images and processed the data afterward by using software Mmimcs. Then, we built model for Group A through the cardiac CTA data obtained, and for Group B, we leveraged software 3-Matic to align and joint the ultrasonic images of valves to the right position of the cardiac CT model. By direct observation, we made comparison between the two groups for the data of shapes and the structures of the valves that from CT and ultrasonic, and measured the parameters related to valve ring, including area (A), circumference (C), maximum diameter (Dmax) and minimum diameter (Dmin). We also placed the two images overlapped, then measured the angles between the plane of the two valve rings and worked out the absolute difference of the values measured, performing the correlated analysis.
**Results:** All the 13 patients completed the whole experiment. By direct observation on valves, we noticed that valve shape from ultrasonic was more clear and complete than that from the CT, the parameters of valves between that from CT and that from ultrasonic made no statistic difference (P>, 0.05) and were at high consistency. The mean values and standard deviation of aortomitral angles in both were 3.15°±0.88°,and 2.87°±0.76° respectively. 3D models of two patients were printed and measured, showing the difference of each parameter between the measured value and the digital model was at 0.1–0.3mm.
**Conclusion:** The comprehensive data analysis, ultrasonic heart valve with CT image fusion is feasible. Ultrasonic valve anatomy shows better, disc ring size and stitching location accurate, contribute to improve the 3D printing heart model biofidelity.

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**PISA 3D method avoids the requirement of an angle correction factor for mitral valve area assessment in mitral stenosis**

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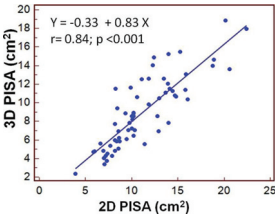
**Introduction:** Two-dimensional (2D) proximal isovelocity surface area (PISA) method has important technical limitations for mitral valve orifice area (MVA) assessment in mitral stenosis (MS), mainly the geometric assumptions of PISA shape and the requirement of an angle correction factor. Recently developed single-beat real-time three-dimensional (3D) color Doppler imaging allows direct measurement of PISA without geometric assumptions nor the requirement of an angle correction factor (see Figure). Our aim is to compare de PISA obtained by the novel 3D PISA method with the PISA obtained by conventional 2D method in patients with rheumatic MS.
**Methods:** Sixty-three consecutive patients with MS were included. Conventional 2D PISA and the novel 3D-PISA were assessed in all patients.
**Results:** Mean age was 68±11 years and 52 patients (82%) were women. Mean 2D PISA was 8.9±3.8cm$^2$, y by 3D PISA 11.1±3.8cm$^2$. A good correlation was obtained between 2D PISA and 3D PISA (r=0.84, p<0.001), see figure; however a consistent significant underestimation PISA was observed with 2D PISA method, probably due to the geometric assumption of the hemispheric shape of PISA with the traditional 2D method. Good intra- and interobserver agreement for 3D-PISA measurements were observed, with an intraclass correlation coefficient of 0.95 and 0.90 respectively. These results were much better than those obtained using the 2D PISA method, with intraclass correlation coefficients of 0.81 and 0.72, respectively.




**Conclusions:** MVA assessment using PISA by single-beat real-time 3D color Doppler echocardiography is feasible in the clinical setting and avoids the requirement of an angle correction factor for mitral valve area assessment in mitral stenosis.

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**Impact of left ventricular size and deformational parameters on ejection fraction in patients with hemodialysis: a study using 3-dimensional speckle tracking echocardiography**

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**Background:** Most hemodialysis (HD) patients have left ventricular (LV) remodeling by pressure and volume overload, which may lead to LV hypertrophy (LVH) and dilation, resulting in heart failure (HF). LV torsion by inner and outer oblique muscle may contribute a part of ejection fraction (EF). Torsion is increased in LVH with endocardial damage. LV dilation is associated with stretching and reorientation of the muscle bundles in such a manner that the relative angle between the main fiber bundles is reduced with fibers in both layers coursing more circumferentially, resulting in reduction of torsion. However, the measurement of LV torsion by echocardiography has been methodologically challenging.
**Purpose:** We assessed the hypothesis that LV dilation and decreased LV torsion at sub-epicardium assessed by 3-dimensional speckle tracking echocardiography (3D-STE) may cause reduced LVEF in patients with HD.
**Methods:** LV volume, strain, twist and torsion at sub-endocardium and sub-epicardium were examined by 3D-STE in 76 HD patients (age 64±12) and 22 controls (age 71±9). Patients with HD were divided into 2 subgroups according to LV size (17 HD with LV end diastolic volume≥70 and 59 HD with volume<70ml/m$^2$). Twist (°) was defined as a difference in rotation angle between base and apex and torsion (°/cm) is defined as twist divided by LV long axis length for every instant in time.
**Results:** LVEF, strain, twist and torsion at both layers in total patients with HD (n=76) were comparable to control (longitudinal strain at sub-endocardium; control: -19±3 vs. HD: -18±4, twist at sub-endocardium; 15.5±5.5 vs. 18.6±8.6°, torsion at sub-endocardium; 2.2±0.7 vs 2.4±1.1°/cm) despite of increased LV