Left ventricle rotation and torsion in athletes with Bicuspid Aortic Valve and mild aortic regurgitation.

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Introduction

Myocardial rotation and torsion have recently been used for the quantitative evaluation of heart contractility in normal subjects, in patients with valvular dysfunction, and also in endurance athletes (1,2). Looking from the ventricular apex, during systole the apex rotates clockwise while the LV base in the counterclockwise sense, and therefore a torsion, often refereed as "twist", corresponds to systole while "untwist" occurs during diastolic recoil. Numerous factors are involved in changes of Left Ventricle (LV) rotation and torsion, including alteration of preload, afterload, heart rate and myocardial pressure overload. All them are normally implicated in the morphological and functional modifications of the heart during physical exercise. Several authors have demonstrated that an increase of LV torsion (3,4) and also a proportional relationship between torsion and LVDD (Left Ventricle Diastolic Diameter), during exercise. In athletes with Bicuspid Aortic Valve (BAV) and mild aortic regurgitation, where regular exercise is generally permitted, a progressive yearly enhancement of all the LV chamber parameters has been recently shown, even though in the normal range.The present study aims to evaluate LV rotation and torsion in BAV athletes and to compare the values with athletes with normal Tricuspid Aortic Valve (TAV) in order to verify any possible differences between the two groups and also to verify the persistence of a normal systolic function in the BAV group.

Materials and methods

Twenty BAV male athletes (age 25±3), and 20 TAV athletes, similar for general characteristics, regularly trained (three times a week for almost 10 months a year) were enrolled in the study. They were practicing different sports (10 soccer, 5 basket, 3 swimming, 2 cycling), included in the same work-load category (5). They were all submitted to general check-up in order to exclude the presence of metabolic disease

Table 1

	BAV (15)	TAV (15)	P
Basal Rotation	**-4.46± 2.4**	**-3.03 ±1.7**	**NS**
Apical Rotation	**+8.64 ±4.0**	**+6.49± 1.6**	**NS**
Torsion	**+12.76±4.2**	**+9.53±2.5**	**.05**
LVDd	**50.5 ±4.4**	**48±4.3**	**NS**
EF	**67.29 ±5.2**	**64.6 ±4.7**	**NS**
CMI	**110.9±20.2**	**95.8±22.9**	**NS**

and also to an echocardiographic examination using My Lab 50 (Esaote, Florence, Italy) echocardiograph equipped with 2.5 mHz probe. Our Ethics Committee approved all the procedures described in the present study, and all the subjects gave their oral informed consent to participate.Statistical analysis was performed using the SPSS 13.0 package for Windows XP. All data are expressed as mean ± as Standard Deviation. The groups were compared using Student's unpaired *t*-test probability value (p) of <0.05 was considered statistically significant.

Echocardiographic examination

From the long axis view, and following the AHA guidelines (6) the standard LV 2D parameters were obtained at rest. The basal 2D systo-diastolic and Doppler parameters inter ventricular septum (IVS) and posterior wall (PW) thickness, left ventricle end diastolic diameter (LVEDD), left ventricle end systolic diameter (LVESD), left atrium (LA) and aortic root (Ao) dimensions, pulse wave Doppler transmitral flow E-wave, A-wave, deceleration time (DT), isovolumic relaxation time (IVRT) were calculated. The evaluation of left ventricular Cardiac Mass Index g/m^2 (CMI) was obtained from Devereux procedure (7), and the EF % was calculated as (EDV –ESV)/EDV, where EDV is the LV end-diastolic volume and ESV is the end-systolic volume. The degree of severity of the valvular insufficiency, described as the extent of the regurgitant jet on a 0 to 4+ scale, was assessed using the colour-flow mapping method from the four-chamber view, according to the ACC/AHA Guidelines (6)

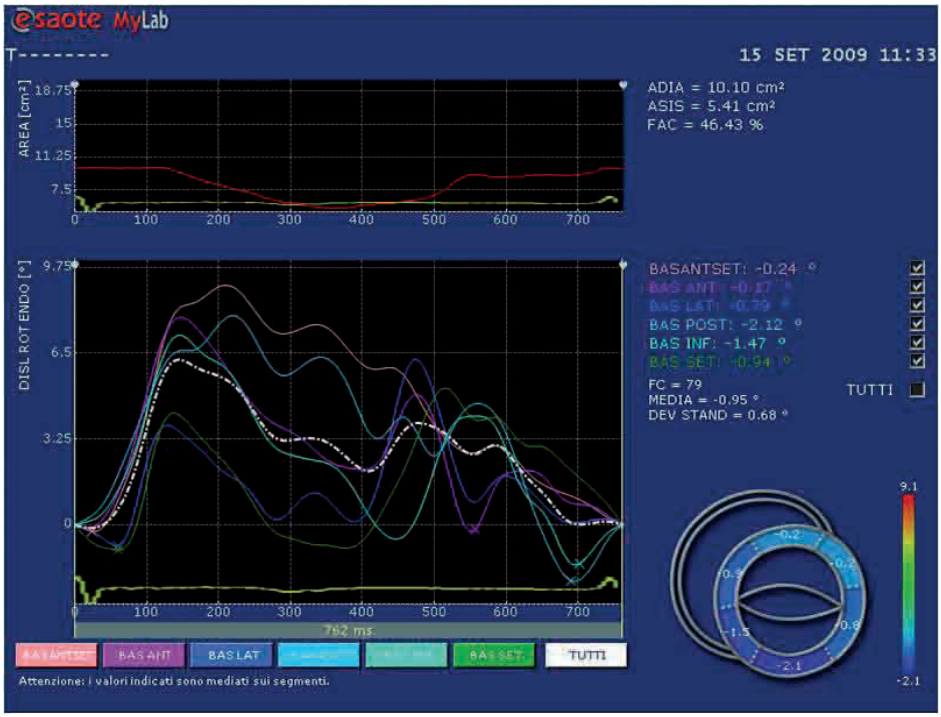

Fig 1: Example of apical rotation measured by speckle tracking, during a complete heart cycle. The value for each segment correspond to a different color.

LV rotation and torsion by Speckle Tracking method

For each subject studied, echo- images at rest of the LV chamber from the short-axis view at the mitral valve plane and apex level, were obtained by the speckle tracking X-Strain software (Esaote, Florence, Italy) included in the echocardiograph (with the maximal resolution of the images approved by technical referees). The software algorithm provides the measure of rotation for each segments and in average value. The calculation of the clockwise and counter-clockwise rotation degree was possible (Fig 1), torsion has been calculated from post processing as the net difference of LV rotation between basal and apical short-axis plane for each subject.

Results

All the subjects enrolled were comparable for general characteristics and BSA. All the values of the rotation and torsion in both groups are presented in the Table 1. It was noticed that the maximal systolic torsion was higher in BAV (12.76±4.2) than in TAV (9.53±2.5), at the upper limit of significance; LV diastolic diameters, EF and CMI didn't show any significant variation .

Conclusions

Rotation and torsion are currently considered as useful parameters to evaluate the heart performance in physiological and pathological hypertrophy (2). Literature reports that torsion usually increases with acute exercise, while a recent assessment of the LV torsion in a group of professional soccer players, (8) using speckle tracking, has demonstrated a reduction of torsion values respect of non-trained individual. Furthermore , a positive relationship has been proven between torsion and LVDD (9). In regularly trained athletes with BAV a progressive yearly increase in LV diameters has been recently shown, although still in the normal range (10). This study demonstrates that torsion in BAV athletes remains within the normal and validated range even if significantly some higher with respect to TAV athletes. In the group studied , this appears to be a consequence of an enhanced rotation at the apical segments respect of TVA. These results confirm the normal LV function in BAV with mild valve dysfunction, but support the relevance of the rotation parameter in order in estimating LV performance during follow-up. The data could be suggestive for a possible straight relationship between BAV torsion and the slight enhancement of the LV dimensions. Anyway this particular aspect , regarding the volume - dependency of torsion values, hasn't been yet exhaustively explored from these preliminary results therefore further investigations will be necessary in future.

References

1. Y NOTOMI, P LYSYANSKY,RM SESTER et all. Measurement of ventricular torsion by two dimensional ultrasound speckle tracking imaging J Am Coll Cardiol 45:2034-41; 2005
2. V RICHAND, S LAFITTE, P REANT, K SERRI et all. An ultrasound speckle tracking(two dimensional strain) analysis of myocardial deformation in professional soccer payers compared with healthy subjects and hypertrophic cardiomyopathy J Am Cardiol 100:128-132;2007
3. TG NEILAN, TT TON–NU, DS JASSAL, EL YELLIN, Myocardial adaptation to short-term high-intensity exercise in highly trained athletes J Am Soc Echocardiogr19:1280-1285;2006
4. M TISHER, J NIGGEL Left ventricular systolic torsion and exercise in normal hearts**.** J Am Soc Echocardiogr 16:670-674; 2003
5. JERE H. MITCHELL, MD, FACC, CHAIR WILLIAM HASKELL, PHD, PETER SNELL, PHD, STEVEN P. VAN CAMP, MD, FACC Task Force 8:Classification of Sports JACC 45, 8, 1364–7;2005
6. CHEITILIN MD, ARMSTRONG WF, AURIGEMMA GR ACC/AHA/ASE 2003 Guideline update for the clinical application of echocardiography: A report of the American College of Cardiology, American Heart Association task force on practice guidelines J Am Soc Echocardiography 10:1091-110;2003.
7. DEVEREUX RB. Detection of left ventricular hypertrophy by M-mode echocardiography. Anatomic validation, standardization and comparison to other methods. Hypertension 20:1251-60;1987
8. Y ZOCALAO, D BIA, R L ARMENTANO, et all. Assessment of training changes in the left ventricle torsion dynamics of professional soccer players using speckle tracking echocardiography. **Conf Proc IEEE Eng** Med Biol Soc1:2709-2712; 2007
9. SJ DONG, PS HEES, WM HUANG et all. Indipendent effects of preload, afterload and contractility on left ventricular torsion. Am J Physiol 277:H 1053-1060; 1999

10. GALANTI G, STEFANI L, TONCELLI L, VONO MCR, MERCURI R, MAFFULLI N Effects of sport activity in athletes with bicuspid aortic valve and mild aortic regurgitation**.** Br J Sports Med june 3 [Epub head of print] 2008