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Analysis of Aortic Stenosis Using Artificial Intelligence

D. Playford [1,*], E. Bordin [2], L. Talbot [2], R. Mohamad [2], B. Anderson [3], G. Strange [1]

[1] *University Of Notre Dame, Fremantle, Perth, Australia*
[2] *Alerte Echo IQ, Perth, Australia*
[3] *The Prince Charles Hospital, Brisbane, Australia*

Introduction: Echocardiographic (echo) evaluation of aortic stenosis (AS) requires multiple measurements to calculate the aortic valve area (AVA). We evaluated whether artificial intelligence (AI) could impute the AVA from other echocardiographic data, without the need for any left ventricular outflow tract (LVOT) measurements.

Method: Our AI was taught the phenotypic response of the heart to AS, then used to predict AVA. We extracted 530,884 echocardiograms from 358,661 participants using National Echo Database Australia. Using a random 70% subset of data we produced an AI model using multidimensional clusters.

Results: We trained the model to impute missing data, with minimal imputation error. The trained model was then tested against the remaining 30% (not previously exposed to the AI). We completely removed all LVOT measurements (velocity, gradient, and diameter) and the AVA from the test set ($n = 24{,}748$ studies) and asked the AI to predict the LVOT and AVA measurements. Severe AS was defined as AVA <1 cm^2. The predicted AVA was then compared with the original calculated AVA. The area under the receiver–operating characteristic curve (AUCROC) was 0.95, and area under the precision recall curve (AUCPR) was 0.73. The model performed equally well in impaired ejection fraction (ejection fraction <50%, 1,391 studies, 10% with severe AS: AUCROC 0.96, AUCPR 0.78; ejection fraction <35%, 426 studies, 10% with severe AS: AUCROC 0.94, AUCPR 0.76).

Conclusion: Our AI system completely removes the need for LVOT measurements in evaluation of AS. Our model performs equally in normal and impaired ejection fraction. AI in echo may improve efficiency, study duration, cost, and risk of sonographer injury.

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Analysis of Improvement in Myocardial Strain Early After Transcatheter Aortic Valve Implantation

D. Ahmed*, E. Barin, M. Ng, B. Coelho, C. Foy-Moxey, R. Hammond

Macquarie University Hospital, Macquarie University, Australia

Introduction: Transcatheter aortic valve implantation, a less invasive intervention, has replaced surgery in patients with severe aortic stenosis (AS) and high or prohibitive surgical risk.

Aim: To analyse changes in left ventricular (LV) global longitudinal strain (GLS) early after TAVI and to correlate these changes to other echocardiographic parameters.

Material and methods: Thirty-one patients (mean age 84 ± 4.9 years, 58% males) with severe AS who underwent TAVI were enrolled. Left ventricular GLS was measured before and early after TAVI. Post-TAVI LV GLS was measured on day 1 (nine patients), day 2 (eight patients), and day 3 (14 patients). Analysis included the impact of factors such as age, sex, LV ejection fraction (LVEF), diastolic indices, and valve type on LV GLS.

Results: A statistically significant improvement was observed in LV GLS early after TAVI (-15.04 ± 3.61 to -16.04 ± 3.71; $p = 0.01$). While LV GLS did not show statistically significant improvement within 48 hours of TAVI, it showed improvement on day 3 (-15.11 ± 3.42 to -16.70 ± 3.67; $p = 0.01$) after TAVI. Post-TAVI LV GLS showed improvement in patients with baseline LVEF <50% ($p = 0.05$), and showed a significant correlation with baseline E/A ratio, a parameter of diastolic function ($p = 0.02$).

Conclusions: Left ventricular GLS improves early after TAVI. Some factors including a lower baseline LVEF and E/A ratio predict improvement in LV GLS early post-TAVI.

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Aortic Size in Turner Syndrome: Relation to Body Composition and Impact of Bicuspid Aortic Valve on Aortic Dilatation and Aortic Growth Rate

A. Lin [1,2,*], A. Rajagopalan [2], H. Nguyen [2,3], A. White [1,2], A. Vincent [2,3,4], P. Mottram [1,2]

[1] *Monash Cardiovascular Research Centre, Department of Medicine (Monash Medical Centre), Monash University and Monash Heart, Monash Health, Clayton, Australia*
[2] *Department of Medicine, Monash University, Clayton, Australia*
[3] *Department of Endocrinology, Monash Health, Clayton, Australia*
[4] *Monash Centre for Health Research and Implementation, Monash University, Clayton, Australia*

Background: The cardiovascular phenotype in Turner Syndrome (TS) includes high rates of aortic dilatation and bicuspid aortic valve (BAV). Due to short stature, aortic diameter index (ascending aortic diameter/BSA, ADI) is currently used to identify TS patients with aortic dilatation.

Aims: 1. To compare aortic growth rate in TS patients with BAV to a reference group of non-syndromic BAV patients; 2. To determine the relationship between different body composition parameters and AD in TS.

Methods: Transthoracic echocardiography (TTE) data retrospectively collected on 130 TS patients at a tertiary centre over 20 years; 62 had serial exams. Body composition data obtained from dual energy x-ray absorptiometry (DXA) in 60 patients within 6-months of baseline TTE. A comparison group of 172 similar-aged non-syndromic BAV patients was identified from a TTE database.