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Aortic Elasticity Evaluation: Ongoing Assertion of M-Mode Measurements

Aortik Elastisite Değerlendirilmesi: M-Mode Ölçümün Devam Eden İddiası

EDITORIAL COMMENT
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Atherosclerosis, a chronic inflammatory disease, is a leading cause of cardiovascular diseases (CVDs) and requires early detection for effective prevention.[1] Arterial stiffness, characterized by the imbalance of elastin and collagen content in the vessel wall, is an early indicator of atherosclerosis.[2] While arterial stiffness is a useful measure for the prediction of stiffness level of all arteries, the concept of aortic stiffness is frequently used in the clinical assessment of it. In clinical practice, it is an important issue to understand the relationship between aortic stiffness and cardiovascular risk factors.

Possible mechanisms linking aortic stiffness and atherosclerosis include common risk factors, mechanical stress on arterial walls, altestress, modynamics, vascular remodeling, and impaired endothelial repair mechanisms.[2] Hypertension, diabetes, dyslipidemia and smoking, which are risk factors for aortic stiffness and atherosclerosis, induce both conditions and lead to endothelial dysfunction, oxidative stress and chronic inflammation. As aortic stiffness increases, it exerts mechanical pressure on the endothelium, impairs its function, increases inflammation and causes plaque formation.[3] Altered hemodynamics due to aortic stiffness raises blood pressure and pulse wave velocity, thereby accelerating atherosclerotic processes in smaller vessels.[4] Arterial stiffness also induces vascular remodeling, stimulating smooth muscle cell proliferation, collagen deposition, and structural changes that promotes plaque formation and aortic stiffness.[2,5] Moreover, aortic stiffness affects endothelial progenitor cells by reducing their mobilization and impairing repair capacity.[6] Knowing these mechanisms focus on the importance of considering aortic stiffness as a modifiable risk factor for preventing and managing atherosclerosis. In addition to atherosclerosis, other cardiovascular events have also been reported to be affected by arterial stiffness. Studies have shown that impaired aortic elasticity is seen in patients with conditions such as heart failure, bicuspid aortic valve, and atrial fibrillation.[7–9]

Echocardiographic evaluation plays a vital role in assessing aortic elasticity parameters, providing valuable insights into the flexibility and stiffness of the aorta. Transthoracic echocardiography (TTE) is a non-invasive and accessible imaging method which is used common for evaluating aortic elasticity by measuring these parameters.[10]

Aortic strain, aortic stiffness index, and aortic distensibility are key indicators of arterial elasticity that can be demonstrated by TTE.[11] Aortic strain measures the extent of deformation or stretching that occurs in the aortic wall during the cardiac cycle.[12] Aortic stiffness index quantifies the resistance of the arterial wall to blood pressure, while aortic distensibility corresponds to the artery's ability to expand and contract with pulsatile blood flow.[13] During the TTE examination, aortic diameters at different phases of the cardiac cycle are measured by specific imaging windows.[14] Blood pressure values are combined with these measurements to calculate the numerous elasticity parameters. The procedure is relatively quick, efficient and requires no additional equipment or software. It helps identify and monitor conditions associated with increased aortic stiffness such as hypertension, atherosclerosis, and other cardiovascular diseases.[15] By evaluating these parameters, healthcare professionals can better recognize a patient's cardiovascular risk profile and tailor appropriate preventive treatments.

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In this issue of the Archives of Turkish Society of Cardiology, an article entitled 'Evaluation of Aortic Elasticity Parameters Measured by Transthoracic Echocardiography in a Normotensive Population: A Single-Center Study" has been published.[16] The study included 405 subjects that are assessed various demographic, clinical, and echocardiographic features. The measurements that are classified as aortic strain, stiffness index, and distensibility indicated arterial elasticity. All of them are based on M-mode measurements as demonstrated in the mentioned article (figure 1). The results demonstrated that these parameters are significantly influenced by age. In this study, the aortic stiffness index was determined to be 3.24 ± 1.05 in the entire population. However, in a study conducted by Vitarelli et al. comparing hypertensive and normotensive patients, the aortic stiffness index value in the normotensive population was found to be 2.92 ± 0.82.[17] It was observed that distensibility and strain decrease, although the stiffness increases with age. In studies evaluating aortic distensibility, normal population values are typically found to be around 10 ($cm^2/dyne^1/10^3$)[18,19], which, considering the age distribution of the values 7.48 ± 2.36 ($cm^2/dyne^1/10^3$) in the current study, appears to be consistent with the literature. The aortic strain values observed in the literature around 11% have been found to be around 15% in this study, and the differences in age groups may explain this discrepancy.[20,21] The study showed that aortic distensibility differs based on gender with higher values in women than men, consistent with reduced protective effect of estrogen after menopause. The results performed that the correlations between aortic elasticity and left ventricular wall thickness, left atrial diameter, and diastolic function indices are found and it emphasizes the impact on cardiac structure and function. This study aids the early identification of increased cardiovascular risk by establishing normal values for aortic flexibility in a normotensive population without cardiovascular disease. Assessing aortic elasticity parameters is crucial to detect and monitor aortic stiffness that contributes to the development of cardiovascular disease. It provides an additional tool to identify individuals at risk, even without traditional risk factors. This research expands our understanding of aortic elasticity, age and gender associations, and cardiac structure.

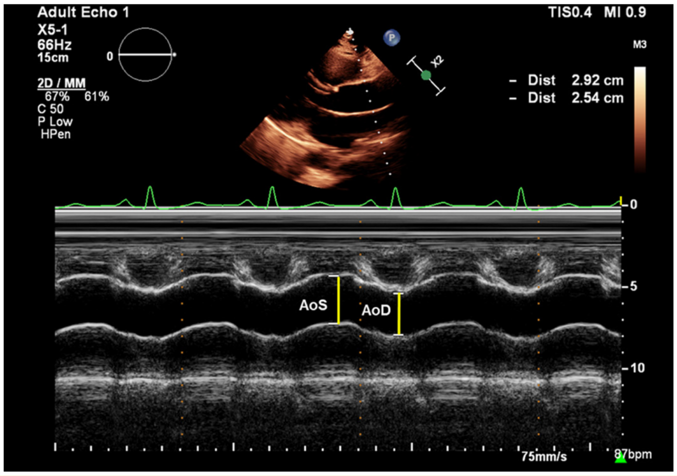

Figure 1. Parasternal long-axis view with M-mode echocardiography showing measurements of systolic aortic diameter (AoS) and diastolic aortic diameter (AoD) from the ascending aorta.[16] Systolic blood pressure (SBP) and diastolic blood pressures (DBP) in addition to the aortic diameters. Aortic strain (%) = 100 × (AoS − AoD)/AoD Aortic stiffness index = ln (SBP/DBP)/aortic strain Aortic distensibility ($cm^2/dyn^1/10^3$) = 2 × aortic strain/pulse pressure[16]

In conclusion, aortic elasticity parameters are important indicators of aortic stiffness, and it is possible to determine these parameters by using echocardiography. The relationship between aortic stiffness and the development of cardiovascular disease emphasizes the clinical significance of assessing aortic stiffness. The evaluation of aortic elasticity parameters can be easily performed with echocardiography. Comparing these measurements with normal values in similar age groups may help to detect increased cardiovascular risk in the early stages, regardless of other risk factors. Future research studies should explore interventions that target aortic stiffness and focus on investigation of the long-term implications of these findings.

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