Original Article

Assessment of Myocardial Performance Index and Aortic Elastic Properties in Patients with Ankylosing Spondylitis

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ABSTRACT

Objective: To assess left ventricular myocardial performance and aortic elastic properties in patients with Ankylosing spondylitis

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Marjan Teaching Hospital's Rheumatology and Echocardiography Units, Babylon, Iraq. from 1st November 2025 to 31st March 2026.

Methodology: There were 60 ankylosing spondylitis patients echocardiography was done for each participant. Myocardial performance index-pulse wave and myocardial performance index-tissue Doppler imaging, aortic strain, distensibility, and stiffness index were assessed by echocardiography. Disease activity was evaluated using Ankylosing Spondylitis Disease Activity Score and C-reactive protein.

Results: Mean aortic stiffness index was 5.9±0.87. myocardial performance index-tissue Doppler imaging correlated positively with aortic stiffness and negatively with distensibility, while Myocardial performance index-pulse wave showed no significant correlations. C-reactive protein-positive patients had higher myocardial performance index values ($p<0.001$). Moderate disease activity was associated with higher myocardial performance index-tissue Doppler imaging ($p=0.020$) and Myocardial performance index-pulse wave ($p=0.012$). Aortic stiffness was the strongest independent predictor of myocardial performance index-tissue Doppler imaging ($\beta=0.453$, $p<0.001$), followed by age ($\beta = 0.296$, $p=0.019$).

Conclusion: Ankylosing spondylitis is associated with subclinical myocardial dysfunction and increased aortic stiffness. myocardial performance index-tissue Doppler imaging may provide a sensitive measure of early cardiovascular involvement.

Key Words: Ankylosing spondylitis, Myocardial performance index, Aortic stiffness, Aortic elastic properties, Echocardiography.

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INTRODUCTION

Ankylosing spondylitis (AS) is a chronic inflammatory disease of the axial skeleton characterized by pain, stiffness, reduced mobility, and vertebral fusion[1]. ASAS established classification criteria for axial and peripheral spondyloarthritis[2], with AS representing radiographic axial spondyloarthritis[3]. HLA-B27 is strongly associated with AS[4], while environmental factors may also contribute to disease development[5].

Cardiovascular involvement is an important extra-articular manifestation associated with increased morbidity and mortality[6]. Cardiac abnormalities occur in approximately 2-10% of patients[7] and include conduction defects, valvular disease, and cardiomyopathy, particularly involving the aortic root, valves, septum, and myocardium[8]. Chronic inflammation contributes to both atherosclerotic and non-atherosclerotic cardiovascular complications[9].

The myocardial performance index (MPI) is a non-invasive measure of global left ventricular systolic and

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diastolic function, derived from conventional Doppler or tissue Doppler imaging using isovolumetric contraction, relaxation, and ejection times[10]. Aortic elasticity can also be assessed non-invasively by echocardiography, with established reference ranges for stiffness, strain, and distensibility[11].

The purpose was to assess myocardial performance and aortic elastic properties to detect subclinical cardiovascular involvement in patients with AS.

METHODOLOGY

This cross-sectional study was conducted in the Echocardiography Laboratory, Echocardiography Department, Mirjan Medical City, Babil Health Directorate, Babylon, Iraq from 1st November 2025 31st March 2026 vide letter No. 124/QM/Approval/dfdfDFVRGd dated January 3, 2025. A total of 60 patients with different sex and age groups who are known case of ankylosing spondylitis were enrolled. Patients aged 20-50 years with established AS were included. Major cardiovascular, metabolic, renal disease, or poor imaging windows were excluded. Age, sex, weight, and medical history were recorded.

LVEF was assessed by M-mode. E/e′ was measured using Doppler and tissue Doppler methods. Left atrial volume was indexed to BSA, while mitral inflow propagation velocity was measured by color M-mode; Vp<50 cm/s indicated impaired relaxation (Fig. 1).

Myocardial Performance Index is a simple and reproducible measure of global ventricular function that does not require precise endocardial border definition. Pulsed-wave MPI was calculated from mitral inflow and LV outflow intervals using the formula MPI = (A-B)/B, where A includes IVCT, IVRT, and ET, and B represents ejection time. A normal MPI is approximately 0.4, while higher values indicate impaired myocardial performance (Fig. 2).

MPI by TDI: Pulsed-wave tissue Doppler imaging was performed in the apical four-chamber view using a 3.5-mm sample volume at the septal and lateral mitral annulus. Ejection time, isovolumetric relaxation time, and isovolumetric contraction time were measured from TDI recordings and used to calculate MPI-TDI (Fig. 3).

The measurement of Ascending aorta diameter was done on M-mode tracing using B-mode based on parasternal long-axis view approximately 3-4 cm above aortic valve as a measure-to-measure aortic stiffness. The diameter was measured on the corresponding electrocardiogram (ECG) at the peak of the QRS in diastole and the maximum anterior movement of the aorta in systole (Fig. 4).

Data were analyzed using IBM SPSS Statistics version 26. Independent t-test, one-way ANOVA, Pearson correlation, and multiple linear regression were applied as appropriate. A p-value <0.05 was considered significant.

RESULTS

Table 1 shows that MPI-TDI correlated positively with aortic stiffness (r = 0.408, p=0.002) and negatively with aortic distensibility (r = −0.299, p=0.020).

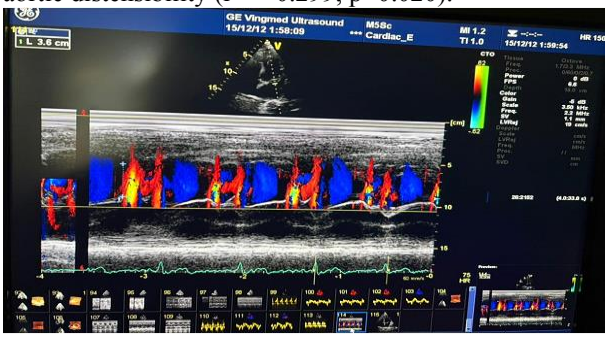


Figure No. 1: Measurement of color M-mode mitral inflow propagation velocity(Vp)



Figure No. 2: Measurement of MPI by pulsed-wave Doppler

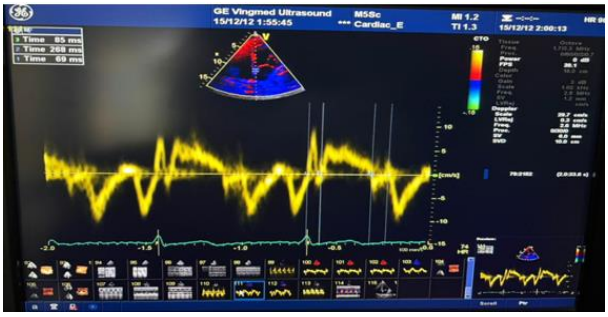


Figure No. 3: Measurement of MPI by TDI

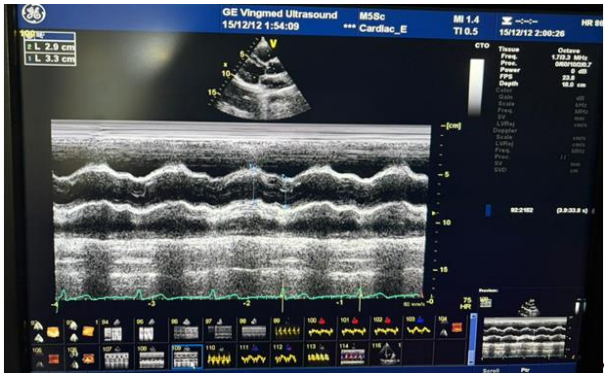


Figure No. 4: Systolic and diastolic diameters measurement of aorta by M-Mode

No significant association was observed with aortic strain. MPI-PW showed no significant correlation with any aortic elasticity parameter. Age had positive correlation with significant difference with myocardial performance ($p<0.05$). Pulse pressure showed a significant positive relationship with aortic rigidity index ($r=0.412$, $p=0.001$). aortic rigidity or myocardial performance were not correlated with BMI, disease duration (Table 2). Table 3 showed CRP had a strong association with MPI-TDI ($p<0.05$) and MPI-PW ($p<0.05$), but not associated with aortic stiffness index suggesting an association between inflammatory activity and myocardial performance alterations.

Table 4 showed the effect of activity of ankylosing spondylitis on myocardial performance, aortic stiffness by using ankylosing spondylitis disease activity score (ASDAS). The table showed non-significant associated between ASDAS and aortic stiffness ($p>0.05$) but significant difference with myocardial performance ($P<0.05$).

Table 5 showed effect of AS duration on degree of aortic regurgitation (AR). There was highly significant association between duration of AS and degree of aortic regurgitation ($p<0001$). Increase of duration lead to increase regurgitation grade; mean duration of patients who had no AR was 4.21±2.62 years while mean duration of patients who had trace AR was 9.17±2.52 years and mean duration of patients who had mild AR was 19.20±5.5 years.

The multivariable model explained 34.5% of MPI-TDI variability ($R^2 = 0.345$; $p<0.001$). Aortic stiffness was the strongest independent predictor ($\beta = 0.453$; $p < 0.001$), followed by age ($\beta = 0.296$; $p = 0.019$), while BMI and disease duration were not significant predictors (Table 6).

Table No. 1: Correlation between MPI and aortic stiffness

Variable	r	P value
MPI TDI		
Aortic stiffness index	0.408	0.002
Aortic distensibility	-0.299	0.020
Aortic strain	0.128	0.332
MPI PW		
Aortic stiffness index	0.174	0.184
Aortic distensibility	-0.080	0.544
Aortic strain	0.027	0.838

Table No. 2: Correlation with baseline characteristics

Variable	MPI TDI r(P)	MPI PW r(P)	Aortic stiffness r (P)
Age	0.34(0.04)	0.32(0.01)	-0.03(0.81)
BMI	-0.16(0.20)	-0.08(0.54)	0.13(0.30)
Disease duration	0.25(0.054)	0.19(0.15)	-0.08(0.51)
Pulse pressure	-0.11(0.38)	-0.15(0.26)	0.412 (0.03)

Table No. 3: Association between CRP and MPI and aortic stiffness

CRP	MPI TDI	MPI PW	Aortic stiffness
Positive	0.59±0.09	0.61±0.20	2.41±1.05
Negative	0.44±0.06	0.39±0.06	2.08±0.70
p-value	<0.001	<0.001	0.146

Table No. 4: Effect of activity of AS on myocardial performance and aortic stiffness

ASDAS	No.	Mean±SD	P value
Aortic stiffness index			
Inactive disease	32	6.2±0.69	0.540
Moderate disease	28	5.6±1.03	
MPI TDI			
Inactive disease	32	0.47±0.07	0.020
Moderate disease	28	0.53±0.13	
MPI PW			
Inactive disease	32	0.43±0.10	0.012
Moderate disease	28	0.53±0.20	

Table No. 5: Effect of duration of disease (years) in AS on degree of aortic regurgitation (AR)

Degree of AR	No.	Mean±SD	P value
None	38	4.21±2.62	<0.001
Trace	12	9.17±2.52	
Mild	10	19.20±5.5	

Table No. 6: Multivariate regression analysis

Variable	B	95% CI	Standardized β	t	P value
Age	0.004	0.001- 0.007	0.296	2.425	0.019
BMI	-0.006	-0.013- 0.001	-0.187	-1.648	0.105
Disease duration	0.002	-0.003-0.007	0.112	0.888	0.379
Aortic stiffness index	0.056	0.029- 0.083	0.453	4.103	<0.001

$R = 0.587$, $R^2 = 0.345$, Adjusted $R^2 = 0.297$, $F = 7.239$, Overall model $P <0.001$

DISCUSSION

This study demonstrated subclinical myocardial dysfunction and impaired aortic elasticity in patients with ankylosing spondylitis (AS). Elevated MPI-TDI despite preserved conventional echocardiographic findings supports its value for detecting early cardiac involvement[12]. Heslinga et al[13] have reported left ventricular diastolic dysfunction in 9-45% of AS patients despite preserved ejection fraction.

Both MPI-TDI and MPI-PW were elevated, indicating impaired global myocardial performance. Chronic

inflammation, including TNF-α-mediated fibrosis and microvascular dysfunction, may contribute to these abnormalities[14]. Similar increases in MPI have been reported by Acar et al[15] and Yildirir et al[16].

C-reactive protein positive patients had higher MPI values, and moderate disease activity was associated with increased MPI-TDI and MPI-PW. These findings support an association between inflammatory activity and myocardial dysfunction[15]. Similar relationships between disease activity and MPI have been reported by Okan et al[17] and Bodakçi et al[18].

Mean Vp was 44.00±5.6 cm/s, suggesting impaired ventricular relaxation despite otherwise preserved diastolic indices[19]. Aortic stiffness was also increased, with reduced distensibility indicating impaired vascular compliance, consistent with previous reports in AS[20].

Aortic stiffness correlated with pulse pressure but not with CRP or ASDAS, suggesting that vascular changes may reflect cumulative rather than current inflammatory activity. MPI-TDI correlated positively with aortic stiffness and negatively with distensibility, whereas MPI-PW showed no significant association, supporting greater sensitivity of MPI-TDI[21].

Aortic regurgitation severity increased significantly with longer disease duration ($p<0.001$), supporting progressive aortic root and valvular involvement in longstanding AS[22].

CONCLUSION

Patients with AS showed subclinical myocardial dysfunction and increased aortic stiffness. MPI-TDI was more sensitive than MPI-PW and independently associated with aortic stiffness. Myocardial impairment was related to inflammatory activity and age, while longer disease duration was associated with greater aortic regurgitation. Combined myocardial and aortic assessment may help detect early cardiovascular involvement in AS.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Zahraa Ayed Al-Hassani, Ali Jaber Al-Maamori
Drafting or Revising Critically:	Zahraa Ayed Al-Hassani, Ali Jaber Al-Maamori
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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