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# Evaluation of subclinical myocardial dysfunction using speckle tracking echocardiography in patients with ankylosing spondylitis

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***Abstract*---**Objective: Ankylosing spondylitis is a part of diseases called "seronegative spondyloarthropathy". Affects the vertebral column, sacroiliac joint and peripheral joints. This chronic rheumatic disorder involved extra -articular parts like Heart, lungs, central nervous system and eyes. Ankylosing spondylitis lead to multiple cardiac complication such as systolic and diastolic dysfunction of left ventricle, valvular involvement, inflammation of aorta and pericardium with enlargement of the heart. Aim of the study: To evaluate of systolic and diastolic left ventricle dysfunction by echocardiography with speckle tracking in ankylosing spondylitis patients. Method: Fifty adult patients with Ankylosing Spondylitis fulfilling the inclusion criteria coming to outpatients of Merjan Medical City were recruited, diagnosed according to the criteria of the American College of Rheumatology criteria; 2D Echocardiography, Tissue Doppler Imaging and Speckle Tracking Echocardiography was done. Statistical analysis of correlation was done with Chi-square test and t-test, the statistical significance was taken $P < 0.05$. Results: There was a significant lowering in the mean of global longitudinal strain in ankylosing spondylitis patients than in control ($p = 0.047$*). There is a significant in versus relationship of global longitudinal strain with tricuspid regurgitation velocity, E velocity, E/A, lateral e' and septal e' ($P = 0.011$*, $P = 0.018$*, $P = 0.018$*, $P = <0.001$* and $P = <0.001$* respectively) also a positive significant relationship of global longitudinal strain with (age, lateral E/e', septal E/e' and average E/e'($P = 0.001$*, $P = 0.004$*, $P = 0.024$* and $P = 0.004$* respectively).

Conclusion: In ankylosing spondylitis patients the global longitudinal strain was normal but statistically significant lower value from control patient. There was subclinical systolic and diastolic left ventricle dysfunction in ankylosing spondylitis patients by global longitudinal strain.

***Keywords***---global longitudinal strain, echocardiography, systole and diastole dysfunction, ankylosing spondylitis.

## Introduction

Ankylosing Spondylitis (AS) is a progressive main subtype of spondyloarthritis that affects primarily axial skeleton, sacroiliac joints, oligoarthritis of hips and shoulders [(1)]. AS involved other parts of body like eyes causing anterior uveitis and enthesopathy that are commonly progress to significant functional disabilities which affect the quality of life and increase the risk of comorbidity [(1)]. Also AS affecting skin, lung, and cardiovascular system [(2)]. AS usually begins at age 26 years, present more in men than women [(3)], with male: female ratio 3: 1 [(4)]. AS more common in white than black people, it's prevalence related to prevalence of human leukocyte antigen (HLA-B27) [(5)]. HLA-B27 and clinical variants of AS differ from one country to the other due to genetic and environmental conditions [(6)]. In Iraq, the prevalence of AS was (0.13%) and about 84% of Iraqi AS patients are positive HLA-B27, 2.1% of healthy Iraqi persons have positive HLA-B27 [(7)]. The rheumatic diseases caused multiple inflammatory processes that leading to many heart disease, mainly atherosclerosing changes [(8)], these inflammatory processes are similar in its frequency in AS, psoriatic arthritis and rheumatoid arthritis, [(8)].

### Cardiac involvements
### Conduction lesions

The first cardiac finding is conduction abnormality, which appeared before valve insufficiency [(9)]. 20% of patients with permanent pacemakers found to be positive for HLA-B27 [(18)]. AV block (first degree) had more common in AS patients than normal, this block defect related to disease severity and duration [(18)]. Two important theories in the causes of conduction changes in AS patients:

- Damage of interventricular septum wall by inflammatory processes.
- Dysfunction of AV node due to stop arterial supply to this node [(27)].

### Valve lesions

Aortic valve and root involvement mostly related to duration of disease [(10)]. Aortic valve insufficiency occurred most commonly than mitral valve insufficiency [(10)]. In young AS patients with age under 60 years, the prevalence of valve disease, observation of aortic insufficiency about (3.3- 16 %), mitral insufficiency about (0-32%), pulmonary insufficiency found in (3%) and also involvement of tricuspid insufficiency in (2-77.6%), (aortic insufficiency mild in 9.1%, moderate in 6.8-9%),

(mitral insufficiency mainly mild in 20.5% and moderate in 9-11.4%) , also there was mitral valve stenosis in 1.5% [11] .

**Systolic and diastolic dysfunction**

The Simpson's method or the "rule of discs." for measuring the ejection fraction of the left ventricle is most common method used in research work and clinical reports [25]. AS causing a varying degree of systolic dysfunction and myocardial abnormalities [20]. Also AS cause diastolic dysfunction in 20 -50 % of patients [21,22], by decreasing early diastolic filling (E-wave) and increasing late diastolic filling ( A- wave) [23] . In AS, the diastolic dysfunction not lead to diastolic cardiac failure [24] .

**Two dimensional speckle tracking imaging (2 D-STI)**

A new technique in recent years was appeare, two dimensional speckle tracking imaging (2D-STI) which is angle-independence that was tracking the speckle, then processing the image and evaluation of global and local deformation of myocardium [12,13]. The high sensitivity of speckle tracking echocardiography (STE) made the early detection of subclinical left myocardial dysfunction very easy before the appearance of symptomatic myocardial abnormalities and change in left ventricular (EF) as assessed by two-dimensional echocardiography [14,15]. Left ventricular global longitudinal strain (LV-GLS) has long term prognosis in many cardiac diseases such as heart failure and valvular heart conditions [16,17]. When there was contraction of the left ventricle in systole, the myocardial fibers shortening in the longitudinal and circumferential direction give (negative strain) wile thickening in the radial direction give (positive strain) [26]. The different in length or thickness is calculated as a percentage of its diastolic length or thickness, and was termed as the (strain or deformation) [27,28]. 60% of the left ventricular ejection result from the longitudinal shortening and it was the major important part of systolic function from base to apex [27].

**Patients and Methods**

This study was analytic case control study, was done in Merjan teaching hospital from (November 2021 to April 2022) on peoples with Ankylosing Spondylitis and control, who attended to Rheumatology and ECHO unit in Merjan teaching hospital. A total number of Ankylosing spondylitis patients was 50 (43 males, 7 females; with mean age 38.00 ± 9.43 years ranging 25-67 years); and 50 control gender, and age matched (43 males ,7 females; with mean age, 38.92 ± 9.84 years ranging 25- 67 years). We take all patients and control in sinus rhythm condition, and patients diagnosed according to ACR (American College of Rheumatology criteria). We exclude any patient with:

- CAD and HF with EF% less than 53%
- HTN , DM, COPD and arrhythmia.
- CMP, CKD, liver disease, thyroid disease and anemia.

History of stroke, poor echogenity that affect STE.

**Questionaire**

Our questionaire contain dermatographic features for all patients and control, history, the body surface area (BSA) was measured by Mosteller method formula = [height (cm) × weight (kg) / 3600]1/2.
BMI formula = weight(kg)/ height $^2$ (normal, overweight, and obese categories are 18.5-24.9 , 25-29.9 , and ≥ 30 kg/m$^2$, respectively).

**Echocardiography**

We use Affiniti 70 C Philips echocardiography machine made in USA with transducer S 5-1 (5 MHZ). Using 2D, Doppler echocardiographic, Tissue Doppler Image (TDI), and speckle tracking strain for Global Longitudinal Strain (GLS) in patients and control examination according to the (American Society of Echocardiography / European Association of Echocardiography guidelines) [29, 30]. Measuring of the global longitudinal strain, by using three sampling points placed manually on the apical endocardium, septal mitral annulus and lateral mitral annulus during end-diastole at apical two chamber, apical three chamber, and apical four-chamber views. Then software tracked the endocardial velocities automatically at these regions. The myocardial speckle tracking was assessed visually, and process manually if need to correct tracking. Then graphics of longitudinal strain parameters of each myocardial segment appear automatically, and the average values of peak systolic strain was calculated. A normal value of GLS was (20%).

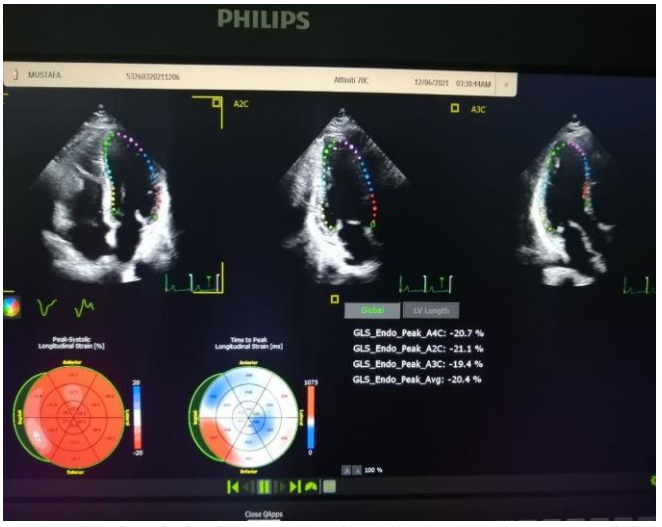

Figure 1. Assessments of (Global Longitudinal Strain) by Speckle Tracking Strain

Statistical analysis was carried out using SPSS version 27. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). Student t-test was used to compare means between two groups. Pearson's correlation coefficient (r) was used to find the relationship between two continuous variables. Pearson chi-square was used to find the association between categorical variables. A *p*-value of ≤ 0.05 was considered as

significant. The chief restrictions of the research have been the minor number of participants. There was a shortage in recording and following up the patients prospectively to detect the development of heart failure or valve disease.

**Results**

The distribution of patients with Ankylosing spondylitis according to study variables including (age, gender, body mass index, smoking habit, physical activity , family history of disease and type of treatment).

Table 1
The Distribution of patients with Ankylosing spondylitis according to patients characteristics (N=50)

| Study variables | | |
|---|---|---|
| Age (years) | (38.00 ± 9.43) | (25.0 - 67.0) |
| Gender | | |
| Male | 43 | 86.0% |
| Female | 7 | 14.0% |
| Total | 50 | 100.0% |
| Body mass index (kg/m$^2$)* | | |
| Underweight (<18.5) | 2 | 4.0% |
| Normal (18.5-24.9) | 16 | 32.0% |
| Overweight (25-29.9) | 20 | 40.0% |
| Obese (≥ 30) | 12 | 24.0% |
| Total | 50 | 100.0% |
| Smoking habit | | |
| Smoker | 21 | 42.0% |
| Non smoker | 29 | 58.0% |
| Total | 50 | 100.0% |
| Physical activity | | |
| Positive | 13 | 26.0% |
| Negative | 37 | 74.0% |
| Total | 50 | 100.0% |
| Family history | | |
| Positive | 19 | 38.0% |
| Negative | 31 | 62.0% |
| Total | 50 | 100.0% |
| Type of treatment | | |
| IV biological infusion | 50 | 100.0% |
| Total | 50 | 100.0% |

***** Mean BMI was (26.42 ± 5.25) kg/m$^2$.

The mean differences of global longitudinal strain (GLS %) according to study groups including (patients with Ankylosing spondylitis and control group).There were significant differences between means of global longitudinal strain (GLS %) between patients and control .

Table 2
The mean differences of GLS (%) between patients and control

| Study variables | Study groups | N | Mean ± SD | t-test | P-value |
|---|---|---|---|---|---|
| GLS (%) | Ankylosing spondylitis | 50 | -18.32 ± 3.39 | 2.023 | 0.047* |
| | Control group | 50 | -19.36 ± 1.26 | | |

*P value ≤ 0.05 was significant

The correlation between GLS (%) and study variables including (age, BMI, BSA, duration of disease, ejection fraction, inter ventricular septum, posterior wall, left ventricle end diastolic dimension, left ventricle end systolic dimension, tricusped regurgitation velocity, E velocity, A velocity, E/A ratio, deceleration time, left ventricle end diastolic volume, left ventricle end systolic volume, lateral s prime, lateral e prime, lateral A prime, lateral E/e ratio, septal s prime, septal e prime, septal A prime, septal E/e' ratio, average E/ e', left atrial volume and left atrial volume index) among patients with Ankylosing spondylitis. There is a significant in versus relationship of GLS with TR.V, E.V, E/A, L.e' and S.e' also apositive significant relationship of GLS with age, S.E/e', average E/e'.

Table 3
Show the correlation between GLS (%) and other parameters among patients with Ankylosing spondylitis (N=50)

| Study variables | GLS (%) | | |
|---|---|---|---|
| | N | r | P-value |
| Age (years) | 50 | 0.446 | 0.001* |
| BMI (kg/m$^2$) | 50 | 0.168 | 0.245 |
| BSA (m$^2$) | 50 | 0.271 | 0.057 |
| Duration of disease (years) | 50 | 0.182 | 0.207 |
| Ejection fraction (mmHg) | 50 | 0.04 | 0.784 |
| IVS (mm) | 50 | 0.249 | 0.082 |
| PW (mm) | 50 | 0.015 | 0.918 |
| LVEDD (mm) | 50 | -0.146 | 0.312 |
| LVESD (mm) | 50 | -0.068 | 0.639 |
| TRV (cm/s) | 50 | -0.355 | 0.011* |
| EV (cm/s) | 50 | -0.334 | 0.018* |
| AV (cm/s) | 50 | 0.236 | 0.099 |
| E/A | 50 | -0.282 | 0.047* |
| DT (ms) | 50 | 0.174 | 0.228 |
| LVEDV (ml) | 50 | -0.103 | 0.476 |
| LVESV (ml) | 50 | -0.18 | 0.211 |
| L. s ' (cm/s) | 50 | -0.141 | 0.327 |
| L.e' (cm/s) | 50 | -0.585 | <0.001* |
| L. a' (cm/s) | 50 | 0.163 | 0.259 |
| L E/e' | 50 | 0.398 | 0.004* |
| S. s ' (cm/s) | 50 | -0.22 | 0.125 |
| S.e' (cm/s) | 50 | -0.509 | <0.001* |
| S. a' (cm/s) | 50 | 0.077 | 0.597 |

| | | | |
|---|---|---|---|
| S E/e' | 50 | 0.319 | 0.024* |
| Average E/e' | 50 | 0.401 | 0.004* |
| LAV (ml) | 50 | -0.099 | 0.495 |
| LAVI (ml/m$^2$) | 50 | -0.206 | 0.15 |

**Discussion**

By 2 D STE we find that AS patients has subclinical myocardial systolic dysfunction compared to the control. In this study AS increase in patient with overweight BMI from 25-29.9 kg/m2 (40% of patients) due to limitation of movements and exercises that results from severe pain , and more in negative family history of disease that agree with Emren et al [31] that show mean BMI 24±4.3, more in male than female this agree with El Maghraoui et al [4] and Emren et al [31] . More in non-smoker with limited physical activity which disagree with Emren et al [31] that show the increasing of AS disease among positive smoking due to their habits . In our study we find significant reduction in GLS % -18.32±3.39 :p=0.047 of AS patient in comparison with control, this agree with other study like Ustun et al [13] show that by STE, there was reduction in myocardial systolic function in AS patients , in absence of CVD.

Also in Chen et al [32] showed that by using advanced 2-STE, AS patients had subtle left ventricular systolic dysfunction (GLS), even with normal LVEF. We find in our study, mean GLS values of AS patients was within the normal value, but lower GLS values statistically than the normal GLS value, and even without cardiovascular risk factors there was reduction in myocardial functions by using STE despite a normal EF. In comparison of GLS with the other parameters ; we found that GLS significantly correlate inversely with (TR .V P=0.011, E.V P=0.018, E/A P=0.018 , lateral e' P=<0.001 and septal e' P=<0.001) and significantly correlate positively with (age P=0.001, lateral E/e' P=0.004, septal E/e' P=0.024 and average E/e' P=0.004) .

**Conclusion**

- In AS patients the GLS was normal but statistically significantly lower than control patient.
- There was subclinical systolic and diastolic left ventricle dysfunction by GLS in AS patients.

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