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Evaluation of left atrial functions in familial Mediterranean fever using speckle-tracking echocardiography: a case-control study

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SOUHRN

Cíl: Je známo, že v patogenezi fibrilace síní hraje významnou roli systémový zánět. Familiární středomořská horečka (familial Mediterranean fever, FMF) je chronické zánětlivé onemocnění charakterizované – v období mezi akutními atakami – perzistentními zánětlivými procesy. Tyto zánětlivé procesy přispívají k fibróze síní, a mohou tak vést k poruše funkcí levé síně. Cílem této studie bylo změřit parametry deformace levé síně u pacientů s FMF a srovnat je s hodnotami zdravých jedinců, a určit tak vliv FMF na deformaci levé síně.
Materiály a metody: Do naší studie bylo zařazeno 40 pacientů s FMF starších 18 let, kteří byli v období mezi atakami, a splňovali zařazovací a vyřazovací kritéria studie. Zároveň byla vytvořena kontrolní skupina 30 zdravých jedinců bez diagnózy FMF. Při echokardiografickém vyšetření se měřily časy levé síně a hodnoty vedení elektrického impulsu levou síní, prováděla se standardní klasická 2D vyšetření, hodnotily se mechanické funkce levé síně a měřily se hodnoty deformace levé síně.
Výsledky: Základní demografické parametry skupin pacientů a kontrol se statisticky významně nelišily. Ve skupině s FMF bylo zaznamenáno větší elektromechanické zpoždění síně ($p < 0,05$). Srovnání mechanických funkcí levé síně obou skupin prokázalo vyšší maximální index objemu levé síně (maximum left atrial volume index, $LAVI_{max}$) u pacientů s FMF ($p = 0,039$). Analýza hodnot deformace levé síně zjistila, že průměrná deformace levé síně v systole (LA strain S, LA S-S) a průměrná deformace levé síně v pozdní diastole (LA strain A, LA S-A) jsou statisticky významně menší u pacientů s FMF ($p = 0,008$, resp. $p < 0,001$).
Závěr: Statisticky významně větší elektromechanické zpoždění a statisticky významně menší deformace levé síně u pacientů s FMF naznačují, že uvedené onemocnění by mohlo být spojeno s poruchou funkcí levé síně. Vyšetření funkcí levé síně těchto pacientů metodou „speckle tracking" – kromě klasických echokardiografických metod – by mohlo přispět k monitorování síňových arytmií při uvedeném onemocnění.

Keywords:
Atrial fibrillation
Echocardiography
Familial Mediterranean fever
Left atrium

ABSTRACT

Objective: It is known that systemic inflammation plays a significant role in the pathogenesis of atrial fibrillation. Familial Mediterranean fever (FMF) is a chronic inflammatory disease characterized by persistent inflammatory processes outside of acute attacks. This inflammatory process contributes to atrial fibrosis, which can lead to impaired left atrial functions. The aim of this study is to investigate the left atrial deformation parameters in FMF patients and compare them with healthy individuals to determine the effect of FMF on left atrial deformation.
Materials and methods: Our study included 40 FMF patients over the age of 18 who were not in an attack period and met the inclusion and exclusion criteria. A control group of 30 healthy individuals without FMF diagnosis was established. Echocardiographic assessments were performed to measure atrial conduction times, standard 2D conventional examinations, left atrial (LA) mechanical functions, and LA strain values.
Results: No significant difference was found in the baseline demographic characteristics of the patient and

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control groups. In the FMF group, a prolongation of atrial electromechanical delay times was observed (p <0.05). When comparing the mechanical functions of the LA between the two groups, the maximum left atrial volume index ($LAVI_{max}$) was found to be higher in patients with FMF (p: 0.039). The analysis of the LA strain values revealed that the average LA strain S (LA S-S) and the average LA strain A (LA S-A) were significantly lower in FMF patients (p: 0.008 and p <0.001, respectively).

Conclusion: The significantly higher atrial electromechanical delay times and the significantly lower LA strain values in FMF patients suggest that this disease may be associated with impairment in LA functions. Evaluating left atrial functions in these patients using speckle tracking strain method, in addition to conventional echocardiographic techniques, may contribute to the monitoring of atrial arrhythmias in this condition.

Introduction

Familial Mediterranean fever (FMF) is an autosomal recessive systemic inflammatory disease that recurs irregularly and is characterized by fever, peritonitis, synovitis, pleuritis, pericarditis, arthritis, and skin lesions.[1,2] The clinical and subclinical cardiovascular effects of FMF have been demonstrated in numerous studies especially with atrial fibrillation (AF).[3] Therefore, patients with FMF are also at risk for cardiovascular involvement.[4,5]

AF is the most prominent type of supraventricular arrhythmias associated with high mortality and morbidity. It is characterized by uncoordinated atrial activation and mechanical dysfunction due to this irregularly activation.[6] In electrocardiography (ECG), instead of regular P waves, small, irregular fibrillation waves with different shapes and amplitudes are seen on the isoelectric line.[7,8] With the remodeling which occurs in the atria, the atrial conduction time is prolonged, and thus the length of the reentry wavelets becomes shorter and more waves are formed. Previous studies have shown that the increase in interatrial conduction time is correlated with the frequency of AF, and the importance of interatrial conduction disorder in the onset and chronicity of AF has been indicated.[9,10] In addition, it is known that systemic inflammation plays an important role in the pathogenesis of AF.[11] Although FMF is a disease that progresses in attacks, it is known that inflammation continues in the non-attack period.[4] The prolongation of the chronic inflammatory process which presents in FMF patients, may contribute to atrial fibrosis, leading to a prolongation of atrial activation time. It has been previously shown that FMF disease causes atrial electromechanical conduction disorders and rhythm abnormalities.[4,5]

P wave duration and P wave dispersion (PWD) analysis in ECG, are methods that can be used to evaluate atrial conductions.[12] PWD values of 40 ms and above are indicative for deterioration of sinus impulse distribution, and it has been determined that, an increase in this time predicts the development of AF.[13,14] Atrial conduction times measured by echocardiography, may provide important clues about arrhythmogenic substrate changes which predispose AF to become chronicity.[15] The electromechanical delay was evaluated with this method in patients with paroxysmal AF and it was shown to be prolonged.[15,16] In additionally interatrial conduction delay times was found higher in FMF patients.[5]

Strain echocardiography is a noninvasive cardiac imaging method based on the tissue Doppler principle. In recent years, speckle-tracking echocardiography has become a preferred technique instead of tissue Doppler-based strain imaging.[17,18] With this method, the strain value can be calculated by monitoring the small echo-intensity points in a region in systole and diastole, frame by frame, and by measuring the distance change between them. Strain echocardiography is also used to evaluate left atrial functions. The relationship between AF recurrence, atrial fibrosis and strain was shown in previous studies.[18,19]

There are no studies in the literature evaluating atrial electromechanical parameters and left atrial functions in FMF patients using the speckle tracking strain method. Our study aims to determine the effects of FMF on left atrial deformation by evaluating the left atrial deformation parameters of patients who are not in the attack period and comparing them with healthy individuals.

Materials and methods

Patients over the age of 18, who were not in the attack period and did not meet the exclusion criteria, were included in our study. The control group was selected from healthy individuals who voluntarily participated in the study and were not diagnosed with FMF. Patients with hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, any rhythm other than sinus rhythm, other autoimmune or inflammatory diseases, collagen tissue disorders, thyroid dysfunction, presence of active infection, anemia, severe valve disease, chronic obstructive pulmonary disease, renal or hepatic dysfunction, electrolyte imbalance, proteinuria or known amyloidosis, left ventricular ejection fraction below 50% or segmental wall motion disorder, primary cardiomyopathy, bundle branch block or atrioventricular conduction disorder, pericarditis, and history of cardioversion were excluded from the study. Pregnant women were not included in the study. All of the patients were under the colchicine treatment. In addition, patients using antiarrhythmic, antidepressant, antipsychotic, and antihistamine drugs were excluded from the study.

Ethical committee

Our study is a prospective research study that was conducted according to the ethical standards of the Declaration of Helsinki, and approved by the Institutional Ethics Committee. Verbal and written consent was obtained from each individual.

Evaluation of atrial conduction times using electrocardiography

The ECGs of the patients were obtained in the supine position with a 12-lead ECG device (Nihon Kohden Corporation, ECG-1350K) in our clinic. ECGs were recorded at a recording speed of 50 mm/s and an amplitude of 20 mm/mV. Participants were allowed to breathe normally while recordings were taken, and they were not allowed to hold their breath and speak. The measurement values were calculated by taking the average of the 3 waves, examined in each lead.

Transthoracic echocardiographic evaluation

Echocardiography was performed by the same physician on all of the patient and control groups, by using GE-Ving Med Vivid 7 system (GE-Vingmed Ultrasound AS, Horten, Norway) ultrasound device and 4S (1.5–4 MHz) probe. Measurements were made in the left lateral decubitus position, accompanied by electrocardiographic rhythm monitoring connected to the device. Standard 2-D echocardiography, M-mode echocardiography, and Doppler methods-related standard conventional examinations were performed from the apical and parasternal windows following the recommendations of the American Society of Echocardiography, and the relevant parameters were calculated according to the guidelines.[20,21] Systolic and diastolic functions of the left ventricle were evaluated. The M-mode method was used to calculate posterior wall thickness, interventricular septum thickness, left ventricular end-diastolic diameter (LVEDd), and left ventricular end-systolic diameter (LVESd). Left ventricular ejection fraction (LVEF) was calculated by biplane Simpson's method. The heart rates of the patients were recorded. Left ventricular mass (LVM) was calculated using the Penn Convention formula. Left ventricular mass index (LVMI) was calculated by dividing left ventricular mass by body surface area (calculated by Mosteller's formula). For standardization, all measurements were taken by holding their breath at the end of expiration.

Evaluation of atrial conduction times by transthoracic echocardiography

Tissue Doppler imaging (TDI) data were obtained in the apical 4-chamber window, by placing the pulse wave Doppler marker coaxially with the direction of movement in the mitral septal, mitral lateral, and tricuspid lateral annulus. Measurements were performed by the recommendations of the American Society of Echocardiography. The velocities and systolic times of the mitral lateral, mitral septal, and tricuspid lateral annular basal segments of the participants were calculated and recorded. Simultaneously, the time interval from the onset of the P wave in the rhythm trace to the onset of the late diastolic flow (A' wave) (called atrial electromechanical junction, PA) was obtained from the mitral lateral annulus, mitral septal annulus, and tricuspid annulus and named as PA lateral, PA septum, and PA tricuspid, respectively. The difference between PA lateral and PA tricuspid (PA lateral-PA tricuspid) was named inter-atrial conduction delay time, the difference between PA septum and PA tricuspid (PA septum-PA tricuspid) as intra-right atrial conduction delay time, difference between PA lateral and PA septal (PA lateral-PA septal) as intra-left atrial conduction delay time.

Evaluation of left atrial functions by transthoracic echocardiography

Left atrial volumes were calculated using the two-plane area-length formula in apical 4 and 2 chamber imaging. Left atrial maximum volume (V_{max}) was calculated at the end of systole just before the mitral valve opening, left atrial minimum volume (V_{min}) at the end of diastole, when the mitral valve is fully closed, and left atrial presystolic volume (V_p) at the beginning of atrial systole (beginning of p wave in ECG).

Left atrial emptying functions were calculated as follows:

Left atrial total emptying volume (LATEV): $V_{max} - V_{min}$

Left atrial total emptying fraction (LATEF) = $(LATEV / V_{max}) \times 100$

Left atrial passive emptying volume (LAPEV) = $V_{max} - V_p$

Left atrial passive emptying fraction (LAPEF) = $(LAPEV / V_{max}) \times 100$

Left atrial active discharge volume (LAAEV) = $V_p - V_{min}$

Left atrial active discharge fraction (LAAEF) = $(LAAEV / V_p) \times 100$

Left atrial expansion index = $(LATEV/V_{min}) \times 100$

The images taken at the beginning of *p* wave with 3 cycles in the apical 4 and 2 chambers were analyzed with the program called Echopac PC, Version 8, GE Healthcare, and a 2D speckle-tracking echocardiographic examination was performed in 6 segments. Left atrial endocardial margins were scanned manually at the end of atrial contraction, the epicardial and mid-myocardial borders were automatically determined by the program, and the region of interest (ROI) was adjusted to include the entire myocardial wall. The quality of the obtained image trace was checked by the device and if there was more than one segment out of 6 segments that did not comply with the quality, the process was repeated. Images with the insufficient image quality of more than one segment were not analyzed. Automatically calculated left atrial strain S (LA S-S), left atrial strain E (LA S-E) and left atrial strain A (LA S-A) values were recorded. The averages of the left atrial strain values obtained in the apical 4 and 2 chambers and calculated by the device were taken.

Statistical analysis

Descriptive statistics are presented with mean, percentage, and standard deviation values. Fisher's exact test or Pearson chi-square test was used to analyze the relationships between categorical variables. The Shapiro–Wilks test was used to control the assumption of normality since the sample size in the group was less than 50. In the analysis of the difference between the measurement values of the two groups, the Mann–Whitney U test was used when the distribution of the data did not fit the normal distribution, and the Student's t-test was used when it did. *P* values less than 0.05 were considered statistically significant. According to the power analysis (alfa error: 0.05, power: 0.8, effect size: 0.6), 68 patients (32 per group) had found to be enough for the study. Analyzes were made with the SPSS 22.0 package program.

Table 1 – Baseline characteristics, laboratory parameters, and conventional echocardiographic findings of the patients and control groups

Variables	FMF patients (n = 40)	Control group (n = 30)	*p*-value
Baseline characteristics			
Age (year)	33.10 ± 11,32	33.9 ± 10.91	0.656
Male, n (%)	24 (60)	19 (63.3)	0.777
BSA (m²)	1.77 ± 0.21	1.85 ± 0.19	0.114
BMI (kg/m²)	23.57 ± 3.82	25.16 ± 3.65	0.085
Systolic blood pressure (mmHg)	119.25 ± 9.02	118 ± 8.15	0.590
Diastolic blood pressure (mmHg)	73.87 ± 6.14	71 ± 6.87	0.086
Heart rate (bpm)	72.27 ± 8.47	76.1 ± 9.81	0.106
Smoke, n (%)	16 (40)	12 (40)	0.922
Laboratory parameters			
Hemoglobin (g/dL)	14.19 ± 1.40	14.39 ± 1.35	0.484
WBC (µL)	7.408 ± 2.129	7.296 ± 1.818	0.863
PLT (fL)	239.450 ± 55.560	250.900 ± 63.418	0.425
Creatinine (mg/dL)	0.78 ± 0.14	0.77 ± 0.14	0.980
ALT (U/L)	26.72 ± 16.89	22.06 ± 9.08	0.376
Conventional echocardiographic findings			
LA (mm)	34.27 ± 3.84	33.5 ± 2.68	0.349
LVDD (mm)	44.07 ± 2.75	46.33 ± 4.42	0.011
LVSD (mm)	26.87 ± 2.65	27.60 ± 3.76	0.348
EF Simpson (%)	69.2 ± 4.84	71.8 ± 6.31	0.055
IVS (mm)	8.97 ± 0.94	9.3 ± 0.95	0.155
PW (mm)	8.95 ± 1.06	8.9 ± 1.06	0.882
LVMI (g/m²)	90.25 ± 12.14	96.03 ± 17.31	0.105
FS (%)	39.37 ± 4.08	40.53 ± 5.04	0.442
Mitral E (m/s)	0.76 ± 0.12	0.79 ± 0.13	0.406
Mitral A (m/s)	0.64 ± 0.13	0.62 ± 0.10	0.713
Mitral E/A	1.24 ± 0.084	1.30 ± 0.072	0.347
EDt (ms)	242.97 ± 51.77	212.06 ± 39.00	**0.008**
IVRT (ms)	86.20 ± 9.45	75.76 ± 8.98	**<0.001**
MPI (%)	0.56 ± 0.08	0.50 ± 0.06	**0.002**
Mitral E/E'	5.90 ± 1.27	5.65 ± 1.29	0.409

ALT – alanine transaminase; BMI – body mass index; BSA – body surface area; CRP – C-reactive protein; E' – mitral lateral and septal annulus mean tissue doppler velocities; EDt – E wave deceleration time; EF – ejection fraction; ESR – erythrocyte sedimentation rate; FS – fractional shortening; IVRT – isovolemic relaxation time; IVS – interventricular septum thickness; LA – left atrium; LVDD – left ventricle diastolic diameter; LVMI – left ventricular mass index; LVSD – left ventricle systolic diameter; MPI – myocardial performance index; PW – posterior wall thickness; SAA – serum amyloid A; WBC – white blood cell.
Bold data indicate statistical significance.

Results

A total of 40 FMF patients, 24 males, and 16 females, between the ages of 18–61 years, and a total of 30 healthy individuals, 19 males, and 11 females, aged 19–60 years were included in the study. The baseline demographic, la-

Table 2 – Left atrial function and mechanics in patients and control group

	FMF patients (n = 40)	Control group (n = 30)	*p*-value
$LAVI_{max}$ (cm³/mL)	20.20 ± 4.55	18.34 ± 5.11	**0.039**
$LAVI_{min}$ (cm³/mL)	7.89 ± 2.74	6.81 ± 2.47	0.094
$LAVI_{p}$ (cm³/mL)	13.21 ± 3.68	11.16 ± 2.81	0.110
LA total emptying volume index (mL/m²)	12.31 ± 3.22	11.52 ± 3.96	0.188
LA passive emptying volume index (mL/m²)	6.99 ± 3.05	7.18 ± 3.30	0.805
LA active emptying volume index (mL/m²)	5.31 ± 2.32	4.34 ± 1.76	0.097
LA total emptying fraction (%)	0.611 ± 0.09	0.624 ± 0.10	0.578
LA passive emptying fraction (%)	0.345 ± 0.12	0.381 ± 0.10	0.193
LA active emptying fraction (%)	0.400 ± 0.12	0.392 ± 0.13	0.819
LA expansion index	172.52 ± 66.18	190 ± 100.35	0.384

LA – left atrium, $LAVI_{max}$ – maximal left atrial volume index, $LAVI_{min}$ – minimal left atrial volume index; $LAVI_{p}$ – left atrial volume index before atrial contraction.
Bold data indicate statistical significance.

Table 3 – Atrial electromechanical delay times of the patient and control groups

	FMF patients (n = 40)	Control group (n = 30)	*p*-value
Inter-atrial PA (ms)	24.62 ± 8.60	12.60 ± 2.58	**<0.001**
Left atrial PA (ms)	14.72 ± 6.15	6.70 ± 2.18	**<0.001**
Right atrial PA (ms)	9.9 ± 5.24	5.90 ± 1.78	**0.003**

PA – time interval from the beginning of the P wave to the beginning of the late diastolic current, atrial electromechanical coupling.
Bold data indicate statistical significance.

Table 4 – LA strain values of patients and control group

Variables	FMF patients (n = 40)	Control group (n = 30)	*p*-value
LA S-S	39.67 ± 10.47	49.79 ± 15.86	**0.008**
LA S-E	22.43 ± 7.38	24.91 ± 8.38	0.138
LA S-A	17.21 ± 5.03	24.88 ± 9.24	**<0.001**

LA S-A – left atrial strain A; LA S-E – left atrial strain E; LA S-S – left atrial strain S.
Bold data indicate statistical significance.

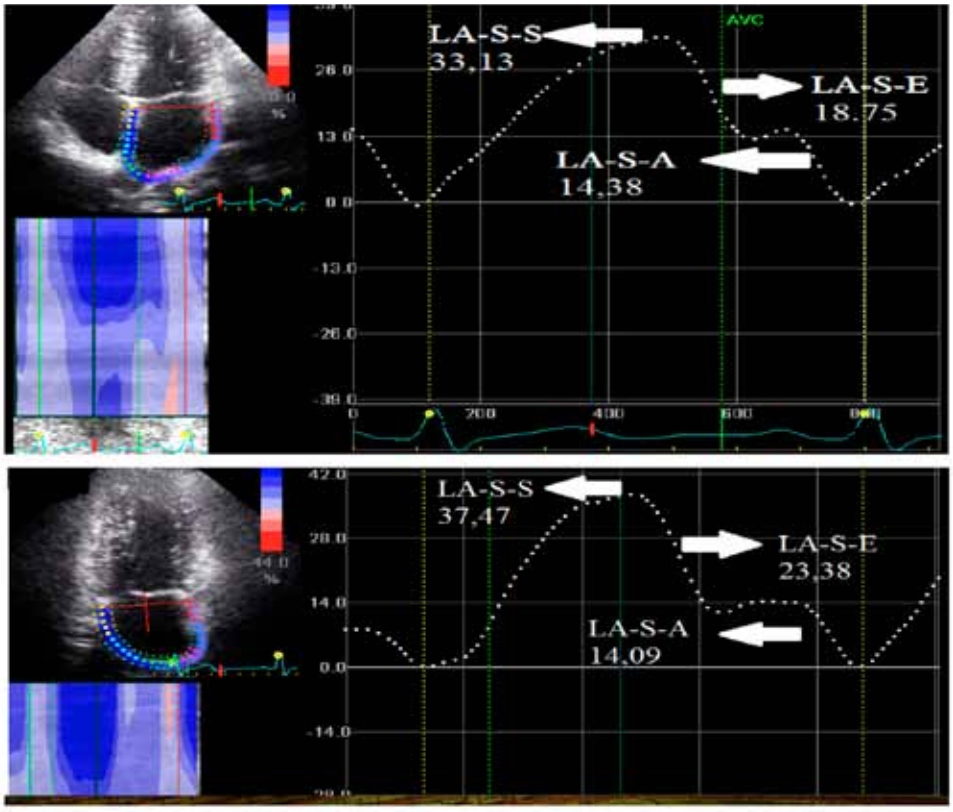

Fig. 1 – Assessment of left atrial functions by 2D speckle tracking method.

boratory, and conventional echocardiographic data of the patient and control groups are shown in **Table 1**. No significant difference was found in baseline characteristics. Only isovolemic relaxation time (IVRT), myocardial performance index (MPI), and E wave deceleration time (EDt) were found statistically higher than the control group (p <0.05).

When the LA mechanical functions of both groups were compared, it was seen that $LAVI_{max}$ was found to be higher in patients with FMF (p: 0.039), but other mechanical function parameters were found to be similar ($LAVI_{min}$, $LAVI_{p}$, emptying fractions and expansion index) (**Table 2**).

Atrial electromechanical conductions times of the both group were compared. Inter-atrial, left atrial and right atrial PA times were found to be statistically longer in FMF group (p <0.001) (**Table 3**).

The LA strain values of the groups were examined and it was observed that the LA S-S mean and LA S-A mean were significantly lower in FMF patients (p: 0.008, p <0.001, respectively). There were no differences between the groups for the LA S-E mean parameter (**Table 4, Fig. 2**).

Discussion

Our study has some findings. Isovolemic relaxation time (IVRT), myocardial performance index (MPI), and E wave deceleration time (EDt) were found statistically higher in pati-

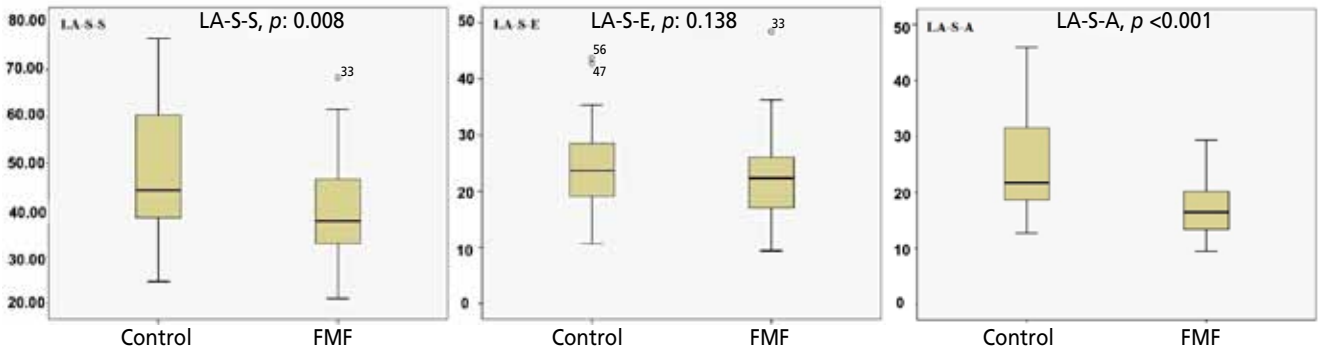

Fig. 2 – LA strain results of patients and control group. LA S-A – left atrial strain A; LA S-E – left atrial strain E; LA S-S – left atrial strain S.

ent group. $LAVI_{max}$ was found to be higher in patients with FMF. Inter-atrial, left atrial, and right atrial PA times were found to be longer in patient group. Finally, LA S-S mean and LA S-A mean were significantly lower in FMF patients.

FMF can affect many organs in the whole body. The most important complication is cardio-renal failure secondary to amyloidosis. Restrictive cardiomyopathy, congestive heart failure, and conduction anomalies can be seen in patients with FMF cardiac involvement.[5–22] The most common form of cardiac involvement is pericarditis. In our study, this finding was not found in any of the patients. The reason for this may be that the patients were examined during the non-attack period and they were all under colchicine treatment.

In 2D echocardiography, the first parameters examined in terms of atrial and ventricular functions are conventional parameters. Prolongation of E wave deceleration time and isovolumic relaxation time are indicators of impaired diastolic functions. The elevation in the myocardial performance index is a quantitative indicator of worsening ventricular function (both systolic and diastolic). In a study left ventricular functions were evaluated in FMF patients, no difference was found in conventional echocardiographic parameters in FMF patients compared to the control group.[23] In another studies, left ventricular myocardial performance index, early diastolic transmitral flow (E), and tricuspid E flow were lower in the FMF group compared to the control group. In addition, right ventricular MPI was found to be significantly increased in the patient group.[24,25] When conventional echocardiographic findings of the groups were compared in our study, E wave deceleration time, isovolumic relaxation time, and myocardial performance index were found to be higher in the FMF group. Additionally, the 2D echocardiography findings of both groups were compared and no difference was found between the two groups.

Although FMF is a disease that progresses in attacks and it is known that systemic inflammation continues in the attack-free period.1 This increased inflammatory state may contribute to atrial fibrosis, leading to prolongation of atrial activation time and may lead to the development of atrial dysrhythmias. Atrial electromechanical conduction time may give us important clues about arrhythmogenic substrate changes that predispose to the chronicity of AF. The atrial electromechanical delay has been evaluated previously in patients with paroxysmal AF and it was shown to be prolonged.[15] In our study, atrial electromechanical delay time data were compared in both groups, it was found that interatrial and intraatrial electromechanical delay times were significantly longer in FMF patients. In a previous study, interatrial and intraatrial electromechanical delay times were found to be significantly longer in the FMF group, similar to our results, and it was stated that this might be due to structural and electrophysiological changes in the atrial myocardium.[5] In another study, pediatric patients with FMF and the control group were compared, and similar to our study, the atrial electromechanical delay times were found to be significantly longer in the FMF group.[26]

In our study, it was observed that the left atrial maximum volume increased in FMF patients. This may be due to an increase in left ventricular filling pressure (due to systolic and diastolic dysfunction). This increase in volume may cause left atrial enlargement, resulting in decreased left atrial compliance, decreased atrial storage, and contractile function over time. No significant difference was found between the two groups in other volumetric parameters. The fact that there is no difference in the conventional values calculated in this way may be insufficient to exclude cardiovascular involvement. This result can also show us the need for a new method to detect the atrial deformation probability.

Left atrial deformation parameters such as left atrial reservoir and contraction strain values were found to be significantly lower in the FMF group. Although the strain value indicating atrial conduction function was less in the FMF group, this difference was not statistically significant. In the literature, no previous study on this subject has been found in the FMF group. The compensatory increase in atrial contraction function, which occurs in conditions with decreased left atrial reservoir and conduction functions, such as hypertension and old age, observed in previous studies, could also be expected in our study. However, in our study, atrial contraction function was found to be decreased compared to passive conduction function. The inflammatory process in FMF, primarily may affect the atrial myocardium and contraction function more. We did not find any significant finding in the correlation analysis of these deformation parameters with the conventional echocardiography findings. We thought that the reason for this result may be due to the small number of our patients, the inaccessibility of all genetic markers, and the lack of advanced tests such as cardiac magnetic resonance imaging which shows cardiac amyloidosis and atrial fibrosis.

Although left atrial reservoir and pump functions were found to be significantly reduced, left atrial conduit function was not significantly impaired. During ventricular systole and early diastole, active contraction is not observed in either atrium. In the reservoir phase of the left atrium, left atrial enlargement is seen, indicating filling from the pulmonary veins into the left atrium. The left atrium passively empties during ventricular relaxation, functioning as a conduction pathway during early ventricular diastole. Atrial functions during this period are significantly influenced by the compliance of the left ventricle. Although we attribute this finding to the left atrium acting as a conduit during early ventricular relaxation, it is not possible to establish this relationship with certainty.

Limitation

Although our study is prospective, the main limitations are the small number of patients and the lack of long-term follow-up of the patients. Other limitations include magnetic resonance imaging or biopsy to demonstrate cardiac amyloidosis and atrial fibrosis, as well as the absence of 24-hour rhythm holter analysis to detect paroxysmal AF.

Conclusion

FMF is a chronic, inflammatory disease and this inflammatory process continues in the non-attack period. Higher

atrial electromechanical delay times and lower LA strain values may indicate that these patients might be at risk for the development of AF. In addition, it seems possible that atrial deformation, which has not yet been detected by conventional echocardiographic methods, can be detected in these patients in the early period with the speckle-tracking strain method. As a result of this, we believe that in addition to periodic cardiological and echocardiographic examinations, left atrial deformation parameters may contribute to suspected patients who will require further cardiac evaluation in early period.

Conflict of interest
None declared.

Researchers' contribution rate statements
Concept/Design: NK,HY; analysis/interpretation: NK,MSK,REA,HY; data collection: NK,VT; writer: NK,VT; critical review: AYK; approver: İD, HY.

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Ethical statement
Clinical Researches Ethics Committee of the Akdeniz University approved the current study with protocol no: 70904504/148.

Informed consent
All patients were enrolled by default and informed with leaflets and posters that they could decline participation at any time.

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