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The right atrium in idiopathic hypereosinophilic syndrome

Insights from the 3D speckle tracking echocardiographic MAGYAR-Path Study

Hypereosinophilic syndrome is characterized by a persistent eosinophil blood count of >1.5 × 10^9 cells/l and organ damage [1]. Since hypereosinophilic syndrome represents a very heterogeneous group of diseases, its definition has been strongly debated for decades. The classification of eosinophilic diseases was revised in the updated 2008 World Health Organization scheme. Thanks to current molecular and immunological diagnostic methods, an etiology-based classification in certain types of hypereosinophilic syndrome is now possible, yet at the price of an even more complicated terminology. The diagnosis of idiopathic hypereosinophilic syndrome can only be established after the exclusion of all primary (clonal) and secondary (reactive) causes of hypereosinophilia [1]. Clinical manifestations of hypereosinophilic syndrome are extremely variable, ranging from asymptomatic conditions to severe tissue damage and end-organ failure directly attributable to hypereosinophilia [2–6]. Cardiac dysfunction is considered to be one of the major causes of morbidity and mortality in hypereosinophilic syndrome [5, 6]. The early stage of cardiac involvement begins with eosinophilic infiltration, followed by an intermediate thrombotic and a late fibrotic stage. The early necrotic stage of cardiac disease is usually neither recognized clinically nor diagnosed in hypereosinophilic syndrome [5, 6]. In recent studies, early signs of left atrial and left ventricular remodeling were detected in patients with hypereosinophilic syndrome without apparent cardiac involvement [7, 8]. The purpose of the present study was to assess right atrial volumetric and functional properties by three-dimensional speckle tracking echocardiography in hypereosinophilic syndrome patients and to compare them with those of age- and gender-matched healthy controls.

Patients and methods

Patient population

A total of 11 patients (mean age: 59.4 ± 11.2 years, six males) with an established diagnosis of idiopathic hypereosinophilic syndrome in sinus rhythm were enrolled in our study [5, 6]. Only one patient had had an anamnestic non-ST-elevation myocardial infarction 3 years earlier with normal epicardial coronary arteries on coronary angiogram at that time. The cardiovascular history of the other participants was not remarkable. The following types noncardiovascular organ involvement were found in the group of hypereosinophilic syndrome patients: duodenal eosinophilia (n = 1); tissue (pulmonary) eosinophilia (n = 1); eosinophilic dermatitis (n = 1); sensory-motor neuropathy with pulmonary involvement and granulomatous necrotizing vasculitis confirmed with sural biopsy (n = 1); and skin involvement (n = 1). Only one patient with hypereosinophilic syndrome had type 2 diabetes mellitus and was on oral antidiabetic medication, while eight subjects were treated for higher blood pressure values and four subjects were on antilipid medications.

The control group comprised 22 age- and gender-matched healthy subjects (mean age: 54.2 ± 12.1 years, nine males). None of the control subjects had risk factors, known diseases, or received any medications.

None of the hypereosinophilic patients or controls had chronic obstructive pulmonary disease or a history of pulmonary embolism or obesity (body mass index ≥30 kg/m^2). There were no clinical or echocardiographic signs of atrial septal defect in any of the patients or controls; however, transesophageal echocardiography was not performed to definitively exclude it. Other malignancies were excluded during the diagnostic process. Complete two-dimensional Doppler and three-dimensional speckle tracking echocardiography were performed on all patients with hypereosinophilic syndrome and on the controls.

The present study serves as a part of the Study *M*otion *A*nalysis of the Heart and *G*reat Vessels b*y* Three-dimensio*n*al Speckle T*r*acking Echocardiography in *Path*ological Cases (MAGYAR-Path), which is conducted at our center to examine, among others, alterations in three-dimensional speckle tracking echocardiography-derived parameters

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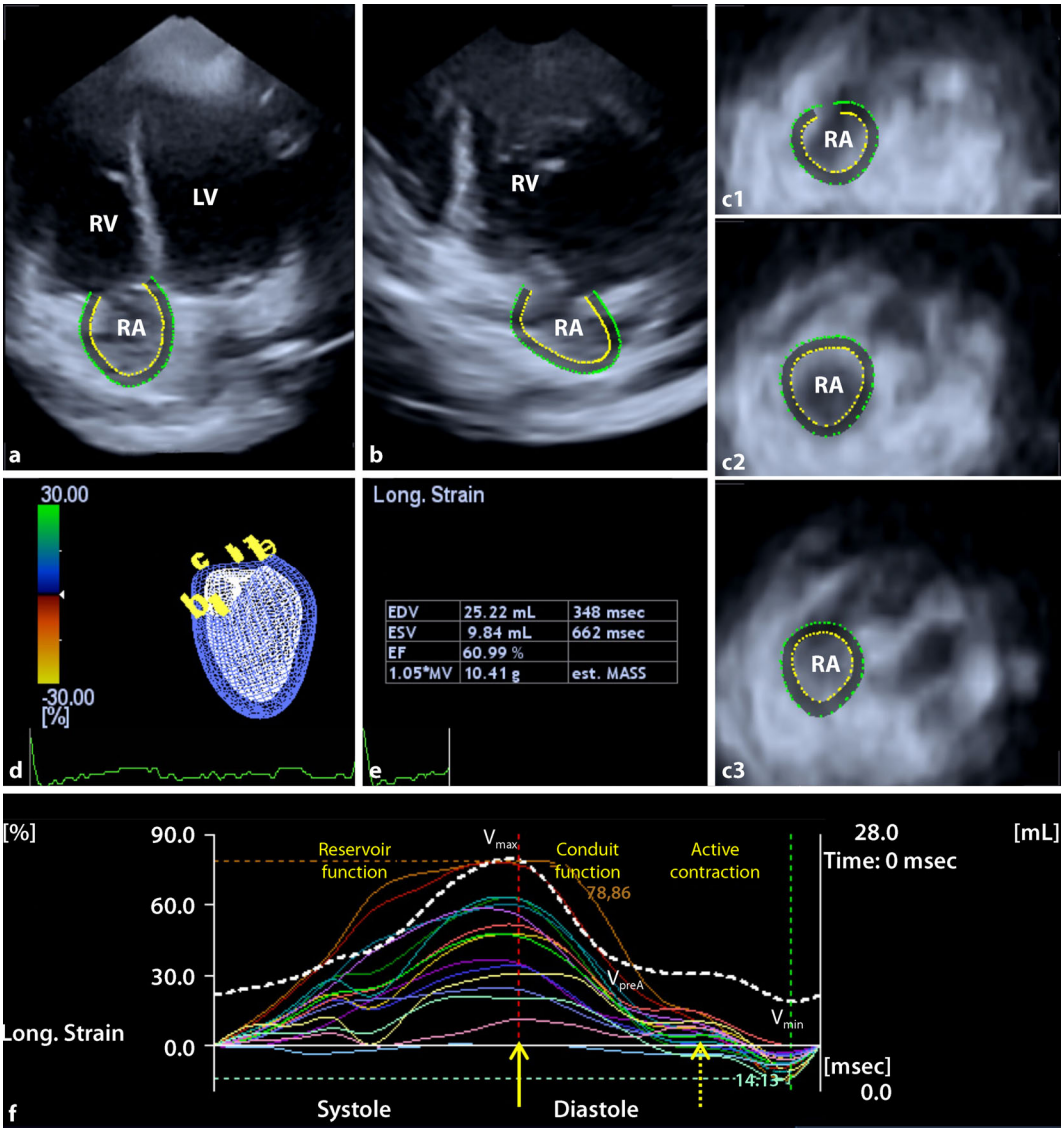

Fig. 1 ◀ Apical four-chamber (**a**) and two-chamber views (**b**) as well as short-axis views at the basal (**c1**), mid- (**c2**), and superior (**c3**) right atrial level derived from a three-dimensional echocardiographic dataset. A virtual model of the right atrium (**d**) and its volumetric data (**e**) during the cardiac cycle together with time–segmental strain curves of all right atrial segments and time–volume changes during the cardiac cycle (**f**). The *yellow arrow* represents peak strain, while the *dashed arrow* represents strain at atrial contraction. V_{max}, V_{min}, and V_{preA} represent systolic maximum and diastolic minimum right atrial volumes and right atrial volume before atrial contraction, respectively. *LV* left ventricle, *RV* right ventricle, *RA* right atrium

in different disorders compared with matched healthy controls ("magyar" means "Hungarian"; [8–10]).

Two-dimensional Doppler echocardiography

Two-dimensional grayscale harmonic images were obtained with the patient in the lateral decubitus position using a commercially available ultrasound system (Artida™, Toshiba Medical Systems, Tokyo, Japan) equipped with a broadband 1–5MHz PST-30SBP phased-array transducer. Measurements of chamber dimensions, volumes, and ejection fraction were obtained in accordance with published recommendations [11]. The degree of mitral and tricuspid regurgitation was visually quantified by color Doppler echocardiography.

Three-dimensional speckle tracking echocardiography

The same Toshiba Artida ultrasound system was used to acquire three-dimensional speckle tracking echocardiographic datasets. A 1–4-MHz PST-25SX matrix phased-array transducer was used for measurements [9]. After optimizing the gain settings, wide-angled acquisitions were recorded, and six wedge-shaped subvolumes were acquired over six consecutive cardiac cycles during a single breath-hold. Raw data were analyzed, and the 3D Wall Motion Tracking software (version 2.7; Toshiba Medical Systems, Tokyo, Japan) was used for right atrial quantifications. Each three-dimensional dataset was displayed in a five-plane view containing an apical four-chamber view, an apical two-chamber view, and three short-axis views at different right atrial levels from the base to the apex. Markers were placed in the apex (superior region) and two others at the edges of the tricuspid valve ring in apical four-chamber and two-chamber views. The software then automatically detected the endocardium and the system performed the three-dimensional wall motion-tracking analysis through the entire cardiac cycle. During evaluations, the right atrial appendage and the caval veins were excluded from the right atrial cavity (**Fig. 1**).

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The right atrium in idiopathic hypereosinophilic syndrome. Insights from the 3D speckle tracking echocardiographic MAGYAR-Path Study

Abstract

Background. Idiopathic hypereosinophilic syndrome is characterized by a persistent eosinophil blood count of >1.5 × 10^9 cells/l and organ damage, independent of the primary and secondary causes of eosinophilia. The purpose of the present study was to assess the three-dimensional speckle tracking echocardiography-derived right atrial volumetric and functional properties between hypereosinophilic syndrome patients and matched controls.
Methods. A total of 11 patients with idiopathic hypereosinophilic syndrome and 22 age- and gender-matched healthy controls were enrolled in the study. Three-dimensional speckle tracking echocardiography was used for calculation of right atrial volumes, volume-based functional properties, and strain parameters.
Results. Significantly increased right atrial maximum (68.7 ± 33.1 ml vs. 40.3 ± 12.1 ml, respectively; $p = 0.001$) and minimum volumes (48.3 ± 31.0 ml vs. 28.3 ± 9.4 ml, respectively; $p = 0.009$), as well as right atrial volume before atrial contraction (58.6 ± 27.3 ml vs. 34.5 ± 11.8 ml, respectively; $p = 0.001$), were found in hypereosinophilic syndrome patients compared with controls. Total and passive right atrial stroke volumes proved to be significantly increased in hypereosinophilic syndrome patients. However, global and mean segmental strain parameters did not differ significantly between the groups.
Conclusion. Increased cyclic right atrial volumes and mild alterations in right atrial functional properties could be demonstrated in idiopathic hypereosinophilic syndrome patients.

Keywords

Echocardiography · Atrial function · Hypereosinophilic syndrome · Eosinophilia · Cardiac disease

Der rechte Vorhof beim idiopathischen hypereosinophilen Syndrom. Erkenntnisse aus der 3-D-Speckle-Tracking-Echokardiogaphie-MAGYAR-Path-Studie

Zusammenfassung

Hintergrund. Das idiopathische hypereosinophile Syndrom ist gekennzeichnet durch eine persistierende Eosinophilenzahl im Blut >1,5 × 10^9 Zellen/l und Organschäden, unabhängig von den primären und sekundären Ursachen der Eosinophilie. Ziel der vorliegenden Studie war es, die in der 3-D-Speckle-Tracking-Echokardiographie ermittelten volumetrischen und funktionellen Eigenschaften des rechten Vorhofs zwischen Patienten mit hypereosinophilem Syndrom und entsprechenden Kontrollen zu vergleichen.
Methoden. Insgesamt wurden 11 Patienten mit idiopathischem hypereosinophilem Syndrom und 22 in Alter und Geschlecht entsprechend ausgewählte gesunde Kontrollen in die Studie aufgenommen. Die 3-D-Speckle-Tracking-Echokardiographie wurde für die Ermittlung rechtsatrialer Volumina, volumenbasierter funktioneller Eigenschaften und von Dehnungsparametern eingesetzt.
Ergebnisse. Eine signifikante Erhöhung der rechtsatrialen Maximal- (68,7 ± 33,1 ml vs. 40,3 ± 12,1 ml; $p = 0{,}001$) und Minimalvolumina (48,3 ± 31,0 ml vs. 28,3 ± 9,4 ml; $p = 0{,}009$) sowie der rechtsatrialen Volumina vor der Vorhofkontraktion (58,6 ± 27,3 ml vs. 34,5 ± 11,8 ml; $p = 0{,}001$) wurde bei Patienten mit hypereosinophilem Syndrom im Vergleich zu Kontrollen festgestellt. Die Gesamt- und die passiven rechtsatrialen Schlagvolumina erwiesen sich bei Patienten mit hypereosinophilem Syndrom als signifikant erhöht. Die globalen und durchschnittlichen segmentalen Deformationsparameter unterschieden sich nicht signifikant zwischen den Gruppen.
Schlussfolgerung. Erhöhte zyklische rechtsatriale Volumina und leichte Veränderungen der rechtsatrialen funktionellen Eigenschaften waren bei Patienten mit idiopathischem hypereosinophilem Syndrom nachweisbar.

Schlüsselwörter

Echokardiographie · Vorhoffunktion · Hypereosinophiles Syndrom · Eosinophilie · Herzerkrankung

Time–global right atrial volume curves were obtained from the three-dimensional echocardiographic datasets allowing for the measurement of maximum and minimum right atrial volumes and right atrial volume before atrial contraction. Maximum right atrial volume was measured just before tricuspid valve opening at end-systole, while minimum right atrial volume and right atrial volume at atrial contraction were measured just before tricuspid valve closure at end-diastole and at the time of the P wave on electrocardiography in early diastole, respectively. The systolic reservoir and early diastolic passive (conduit) and late diastolic active emptying (booster pump) phases of right atrial function were measured from the right atrial volumetric datasets.

Right atrial stroke volumes

- Total atrial stroke volume: maximum right atrial volume—minimum right atrial volume (reservoir function)
- Passive atrial stroke volume: maximum right atrial volume—right atrial volume before atrial contraction (conduit function)
- Active atrial stroke volume: right atrial volume before atrial contraction—minimum right atrial volume (booster pump/active contraction function)

Right atrial emptying fractions

- Total atrial emptying fraction: total atrial stroke volume/maximum right atrial volume×100 (reservoir function)

Table 1 Clinical and two-dimensional echocardiographic characteristics of patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Demographics and risk factors			
Age (years)	59.4 ± 11.2	54.2 ± 12.1	0.17
Male gender (%)	6 (55)	9 (41)	0.54
Two-dimensional echocardiography			
LA diameter (mm)	42.1 ± 6.7	33.8 ± 3.2	0.003
LV end-diastolic diameter (mm)	51.7 ± 11.6	47.6 ± 8.7	0.26
LV end-diastolic volume (ml)	116.0 ± 48.2	100.8 ± 34.7	0.32
LV end-systolic diameter (mm)	34.5 ± 11.9	29.0 ± 4.4	0.08
LV end-systolic volume (ml)	42.9 ± 22.1	32.7 ± 11.0	0.10
Interventricular septum (mm)	10.8 ± 1.3	9.6 ± 1.8	0.05
LV posterior wall (mm)	9.7 ± 1.3	9.5 ± 1.9	0.65
LV ejection fraction (%)	63.4 ± 9.4	66.7 ± 6.9	0.29
E/A	1.79 ± 0.20	1.40 ± 0.20	0.05

E/A ratio of diastolic transmitral flow by Doppler echocardiography, *HES* hypereosinophilic syndrome, *LA* left atrial, *LV* left ventricular

Table 2 Comparison of 3D STE-derived volumetric and volume-based functional right atrial parameters of patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Calculated volumes (ml)			
Maximum RA volume (V_{max})	68.7 ± 33.1	40.3 ± 12.1	0.001
Minimum RA volume (V_{min})	48.3 ± 31.0	28.3 ± 9.4	0.009
RA volume before atrial contraction (V_{preA})	58.6 ± 27.3	34.5 ± 11.8	0.001
Stroke volumes (ml)			
Total atrial SV	20.4 ± 11.0	11.9 ± 5.8	0.007
Passive atrial SV	10.1 ± 8.4	5.8 ± 3.8	0.05
Active SV	10.3 ± 10.9	6.2 ± 4.6	0.13
Emptying fractions (%)			
Total atrial EF	32.0 ± 11.8	30.0 ± 10.1	0.61
Passive atrial EF	13.6 ± 8.6	14.8 ± 8.8	0.71
Active atrial EF	20.9 ± 14.5	17.7 ± 9.3	0.44

3D STE three-dimensional speckle tracking echocardiography, *EF* emptying fraction, *RA* right atrial, *SV* stroke volume, *HES* hypereosinophilic syndrome

- Passive atrial emptying fraction: passive atrial stroke volume/maximum right atrial volume×100 (conduit function)
- Active atrial emptying fraction: active atrial stroke volume/right atrial volume before atrial contraction×100 (booster pump/active contraction function)

Time–strain curves could also be created at the same time from the same three-dimensional echocardiographic datasets. Unidirectional radial, longitudinal, and circumferential and complex area as well as three-dimensional strains were measured. Right atrial global strains were calculated by the software, while mean segmental strains were obtained as the average of strains of the 16 segments devised for the left ventricle. Regional right atrial strain analysis provided superior, midatrial, and basal regional right atrial strain parameters. A typical strain curve has two peaks: The first peak represents characteristics of the reservoir phase, while the second peak represents characteristics of the booster pump phase of right atrial function.

Statistical analysis

All continuous variables are presented as mean ± standard deviation. Categorical data are presented as frequencies and percentages. Comparisons among groups were performed with the Student t test, χ^2 test, and Fisher's exact test, when appropriate. Pearson's correlation coefficient was calculated when needed. A two-tailed p value of <0.05 was considered to indicate statistical significance. All statistical analyses were carried out using the MedCalc software (MedCalc, Inc., Mariakerke, Belgium).

Results

Laboratory findings

Significant differences could be demonstrated between hypereosinophilic syndrome patients and matched controls regarding white blood cell count (15.7 ± 6.5 × 10^9/l vs. 6.6 ± 0.9 × 10^9/l, $p = 0.03$), eosinophil ratio (46.8 ± 17.4% vs. 3.1 ± 2.1%, $p = 0.001$), and absolute eosinophil count (8.0 ± 5.1 × 10^9/l vs. 0.3 ± 0.2 × 10^9/l, $p = 0.01$). Differences did not reach the level of significance for red blood cell count (4.1 ± 0.5 T/l vs. 4.4 ± 0.3 T/l, $p = 0.91$), hemoglobin (127.1 ± 17.9 g/l vs. 131.6 ± 9.9 g/l, $p = 0.84$), platelet count (271.1 ± 168.5 × 10^9/l vs. 280.2 ± 160.0 × 10^9/l, $p = 0.89$), and hematocrit (37.1 ± 5.2% vs. 37.2 ± 5.3%, $p = 0.95$). No correlations could be demonstrated between any of the laboratory findings and two-dimensional echocardiographic and three-dimensional speckle tracking echocardiographic data in this patient population.

Two-dimensional Doppler echocardiographic data

None of the controls and hypereosinophilic syndrome patients had mitral or tricuspid regurgitation of ≥ grade 1. Increased pulmonary arterial pressure was not measured in any of the patients or controls. All other valvulopathies including pulmonary valvulopathy or tricuspid stenosis were excluded. Left atrial diameter, the thickness of the interventricular septum, and the ratio of the diastolic

Table 3 Comparison of 3D STE-derived global and mean segmental peak strain parameters of the right atrium in patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Global strain parameters			
Radial strain (%)	−12.4 ± 7.1	−14.7 ± 9.2	0.47
Circumferential strain (%)	13.0 ± 9.8	9.1 ± 8.3	0.24
Longitudinal strain (%)	23.3 ± 13.3	22.8 ± 1.5	0.84
3D strain (%)	−5.3 ± 4.6	−7.6 ± 5.8	0.26
Area strain (%)	37.0 ± 25.1	30.0 ± 17.5	0.36
Mean segmental strain parameters			
Radial strain (%)	−16.3 ± 6.4	−18.5 ± 8.1	0.46
Circumferential strain (%)	18.1 ± 9.8	14.7 ± 8.3	0.30
Longitudinal strain (%)	26.5 ± 13.3	26.6 ± 9.6	0.99
3D strain (%)	−9.9 ± 4.1	−12.2 ± 6.0	0.26
Area strain (%)	43.6 ± 25.9	37.9 ± 16.6	0.45

3D STE three-dimensional speckle tracking echocardiography, *HES* hypereosinophilic syndrome

Table 4 Comparison of 3D STE-derived regional peak strain parameters of the right atrium in patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Radial strain			
Basal RS (%)	−13.6 ± 6.5	−16.9 ± 6.1	0.16
Midatrial RS (%)	−16.6 ± 5.7	−18.5 ± 9.7	0.54
Superior RS (%)	−20.2 ± 12.0	−20.7 ± 12.2	0.92
Circumferential strain			
Basal CS (%)	16.7 ± 11.8	17.2 ± 10.2	0.91
Midatrial CS (%)	14.6 ± 6.9	12.7 ± 7.5	0.48
Superior CS (%)	25.3 ± 20.7	13.3 ± 15.6	0.07
Longitudinal strain			
Basal LS (%)	32.5 ± 22.3	24.8 ± 12.3	0.21
Midatrial LS (%)	28.6 ± 13.7	37.5 ± 16.2	0.13
Superior LS (%)	14.4 ± 10.1	13.0 ± 8.0	0.67
3D strain			
Basal 3DS (%)	−8.2 ± 4.4	−11.1 ± 5.1	0.12
Midatrial 3DS (%)	−9.6 ± 3.2	−11.6 ± 6.7	0.36
Superior 3DS (%)	−13.1 ± 10.1	−15.0 ± 10.7	0.63
Area strain			
Basal AS (%)	41.9 ± 31.8	34.0 ± 16.5	0.35
Midatrial AS (%)	43.1 ± 23.0	46.8 ± 20.4	0.63
Superior AS (%)	46.9 ± 44.7	30.3 ± 35.7	0.26

3DS three-dimensional strain, *3D STE* three-dimensional speckle tracking echocardiography, *AS* area strain, *CS* circumferential strain, *HES* hypereosinophilic syndrome, *LS* longitudinal strain, *RS* radial strain

transmitral flow by Doppler echocardiography (E/A) were significantly increased in hypereosinophilic syndrome patients compared with control subjects, while the other two-dimensional parameters were similar (**Table 1**).

Three-dimensional speckle tracking echocardiographic data

Significantly increased systolic maximum right atrial volume, early-diastolic right atrial volume before atrial contraction, and late-diastolic minimum right atrial volume were found in hypereosinophilic syndrome patients compared with matched controls (**Table 2**). Increased total and passive atrial stroke volumes were demonstrated in hypereosinophilic syndrome patients suggesting altered right atrial reservoir and conduit functions. Active atrial stroke volume and all emptying fractions did not differ between the groups (**Table 2**). There were no significant differences between the groups in the global, mean segmental, and regional peak strains characterizing right atrial reservoir function (**Tables 3 and 4**). Global and mean segmental right atrial strains at atrial contraction did not differ between the groups, but some regional longitudinal and three-dimensional strains were significantly reduced in the hypereosinophilic syndrome patients (**Tables 5 and 6**). No correlations could be demonstrated between any laboratory findings and three-dimensional speckle tracking echocardiography-derived right atrial parameters.

Discussion

Idiopathic hypereosinophilic syndrome is characterized by persistent eosinophilia in the blood without a known cause of the overproduction of eosinophils and with evidence of eosinophil-mediated organ damage [1–3]. Cardiac manifestations are the major cause of morbidity in hypereosinophilic syndrome and develop in three stages. The first stage is an early acute necrotic stage, when eosinophils and lymphocytes infiltrate the myocardium and hypersensitivity reaction occurs without any typical symptoms or echocardiographic signs. This stage is followed by the thrombotic stage with endomyocardial and valvular involvement and potential thrombus formation. The final fibrotic stage is characterized by endomyocardial fibrosis that may be followed by restrictive cardiomyopathy [2, 5, 6, 12]. In this context, the following typical echocardiographic findings may be found in hypereosinophilic syndrome: endocardial fibrous thickening, thrombus formation, as well as apical obliteration and valvular regurgitation due to restricted motion of the posterior mitral leaflet [13].

Table 5 Comparison of 3D STE-derived global and mean segmental right atrial strain parameters at atrial contraction in patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Global strain parameters			
Radial strain (%)	−3.8 ± 4.7	−6.9 ± 6.4	0.16
Circumferential strain (%)	7.8 ± 9.1	9.3 ± 11.0	0.72
Longitudinal strain (%)	10.4 ± 9.0	9.2 ± 7.9	0.70
3D strain (%)	−2.6 ± 4.4	−4.2 ± 4.7	0.37
Area strain (%)	21.7 ± 23.7	15.8 ± 14.2	0.38
Mean segmental strain parameters			
Radial strain (%)	−8.0 ± 3.8	−9.0 ± 4.7	0.52
Circumferential strain (%)	10.8 ± 7.8	11.7 ± 10.1	0.80
Longitudinal strain (%)	13.4 ± 8.3	8.7 ± 5.5	0.06
3D strain (%)	−5.0 ± 3.5	−6.9 ± 4.4	0.22
Area strain (%)	25.9 ± 21.2	19.4 ± 14.9	0.59

3D STE three-dimensional speckle-tracking echocardiography, *HES* hypereosinophilic syndrome

Table 6 Comparison of 3D STE-derived regional right atrial strain parameters at atrial contraction in patients with hypereosinophilic syndrome and controls

	HES patients ($n = 11$)	Controls ($n = 22$)	p
Radial strain			
Basal RS (%)	−6.3 ± 3.6	−10.0 ± 5.8	0.07
Midatrial RS (%)	−8.5 ± 3.6	−8.2 ± 5.3	0.88
Superior RS (%)	−9.6 ± 8.2	−8.8 ± 5.4	0.75
Circumferential strain			
Basal CS (%)	9.5 ± 8.2	13.4 ± 11.2	0.31
Midatrial CS (%)	7.9 ± 6.3	10.1 ± 8.7	0.46
Superior CS (%)	17.2 ± 18.7	9.1 ± 13.4	0.16
Longitudinal strain			
Basal LS (%)	15.7 ± 14.9	6.8 ± 6.2	0.02
Midatrial LS (%)	14.1 ± 7.6	11.1 ± 7.6	0.29
Superior LS (%)	8.7 ± 7.2	8.3 ± 9.3	0.91
3D strain			
Basal 3DS (%)	−3.8 ± 3.7	−7.7 ± 5.5	0.04
Midatrial 3DS (%)	−5.8 ± 3.0	−6.1 ± 4.3	0.86
Superior 3DS (%)	−5.8 ± 7.2	−6.9 ± 5.2	0.62
Area strain			
Basal AS (%)	24.4 ± 22.3	17.1 ± 11.2	0.22
Midatrial AS (%)	22.3 ± 17.7	22.0 ± 14.2	0.95
Superior AS (%)	33.5 ± 42.9	19.0 ± 30.0	0.27

3DS three-dimensional strain, *3D STE* three-dimensional speckle tracking echocardiography, *AS* area strain, *CS* circumferential strain, *HES* hypereosinophilic syndrome, *LS* longitudinal strain, *RS* radial strain

There are a limited number of studies in which advanced three-dimensional and/or speckle tracking echocardiography was used for chamber quantifications in a series of patients with hypereosinophilic syndrome. In a recent study involving hypereosinophilic syndrome patients with normal conventional echocardiographic findings, two-dimensional speckle tracking echocardiography-derived global left ventricular longitudinal strain was identified as a promising tool for the better management of patients in the very early stage of the syndrome [7]. The recently introduced three-dimensional speckle tracking echocardiography facilitates more detailed chamber quantifications including volumetric measurements and strain assessments at the same time from the same three-dimensional dataset [9]. In a recent three-dimensional speckle tracking echocardiography study from our working group, increased left atrial volumes in the cardiac cycle and mild functional alterations including increase in volume-based functional properties and reduction in global/mean segmental circumferential peak strains representing the reservoir and booster pump phases of left atrial function could be detected in hypereosinophilic syndrome patients [8].

In the present study, most hypereosinophilic syndrome patients were in the earliest asymptomatic necrotic (tissue damage) stage (except for the patient with anamnestic non-ST-elevation myocardial infarction). None of the classic echocardiographic signs of hypereosinophilic syndrome could be detected in any of the hypereosinophilic syndrome patients, suggesting an absence of cardiac involvement. In spite of these facts, increased cyclic right atrial volumes were found together with mild right atrial functional alterations including changes in some volume-based properties and in regional strains characterizing all the phases of right atrial function. Taking into consideration our previous results, only mild left atrial and right atrial functional alterations are suggested to have different characteristics in hypereosinophilic syndrome. These findings could be considered to be the consequence of the degranulation of eosinophils within the eosinophil-infiltrated tissue, which could be associated with necrosis due to the release of toxic cationic proteins [12]. Left and right ventricular (dys)function could also play a role. However, the effect of the increased age of the subjects on right atrial remodeling should also be considered when interpreting the results. Moreover, the effects of classic risk factors and/or medications on the results could not be excluded either.

Limitations

The limited number of idiopathic hypereosinophilic syndrome patients is one of the most important limitations of the study. However, idiopathic hypereosinophilic syndrome is a rare disease. Another limitation is that transesophageal echocardiography to exclude intracardiac thrombi was not performed in any of the cases. However, all patients were in sinus rhythm without any suspicion of a thrombotic process. Tricuspid annular plane systolic excursion and fractional area change of the right ventricle characterizing right ventricular function were not measured and therefore a comparison could not be made with right atrial functional properties. Although the atrial septum is part of both atria, it was considered to be part of the right atrium in this study as in other three-dimensional speckle tracking echocardiography studies [10].

Conclusion

Increased cyclic right atrial volumes and mild alterations in right atrial functional properties could be demonstrated in patients with idiopathic hypereosinophilic syndrome.

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Compliance with ethical guidelines

Conflict of interest. A. Nemes, I. Marton, P. Domsik, A. Kalapos, É. Pósfai, S. Modok, Á. Kormányos, N. Ambrus, Z. Borbényi, and T. Forster declare that they have no competing interests.

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki (and updated versions) and was approved in advance by the local institutional ethics committee. Informed consent was obtained from each subject.

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