

HEART FAILURE WITH PRESERVED LEFT VENTRICULAR EJECTION FRACTION IN PATIENTS WITH NORMAL SINUS RHYTHM AND ATRIAL FIBRILLATION: THE COMPARISON OF RISK FACTORS, SYMPTOMS, LABORATORY FINDINGS, AND ECHOCARDIOGRAPHIC PARAMETERS OF RIGHT VENTRICULAR DYSFUNCTION

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Resume

Chronic heart failure with preserved left ventricular contractile function is of great interest to the modern medical community, especially to cardiologists. In chronic heart failure with preserved left ventricular contractility, the risk factors and comorbidities, including atrial fibrillation, underlying the development of HFpE are of relevance. Right ventricular involvement is a major concern in patients with HFpEF. RV dysfunction is associated not only with the severity of clinical signs and heart failure but also with future prognosis and disease outcome.

As atrial fibrillation itself contributes significantly not only to HFpE development but also to the secondary involvement of the RV in this process, it is interesting to identify possible differences in symptomatology, risk factors, and laboratory and instrumental study responses between patients with sinus rhythm and those with atrial fibrillation.

Methods: We looked at 34 patients with chronic heart failure with preserved left ventricular contractility. We divided the patients into two independent groups based on heart rhythm characteristics: sinus rhythm and atrial fibrillation. The analysis examined the data separately in two different groups and compared the results.

All major risk factors and comorbidities underlying HFpE and the parameters of diastolic dysfunction, as revealed by the increase in pulmonary artery pressure (PAP) and E/e' ratio, and the left atrial volume index (LAVI), were addressed. The functional status of the right ventricle and the incidence and degree of pulmonary hypertension were also investigated using echocardiographic parameters such as right ventricular fractional area (FAC), right ventricular myocardial performance index (RIMP), tricuspid annulus excursion (TAPSE), mean pulmonary artery pressure (mPAP), and tricuspid annular systolic velocity (S'). Finally, we compared the data from the two patient groups.

Conclusion: 1. The most common contributing factors to HFpEF are arterial hypertension, advanced age, atrial fibrillation, and acquired valvular pathology. 2. Increased left ventricular pressure is observed in both HFpEF groups, although this is more strongly related to the concurrent presence of AFib. 3. FAC is the least informative of the echocardiographic parameters of right ventricular dysfunction. TAPSE decreases in both patient groups, with greater decreases in the AFib group. S' is not an important diagnostic marker because of its decrease in a small patient population. The most informative parameter reflecting RV dysfunction is the RIMP, which increases by almost the same amount in sinus rhythm and atrial fibrillation. 4. Right atrial fibrillation is an important marker of right ventricular dysfunction in patients with HFpEF, particularly in AFib. 5. Pulmonary hypertension is present in all patients with HFpEF and AFib, as a secondary symptom of right-sided dysfunction.

Key words: Chronic heart failure with preserved left ventricular function (HFpEF), sinus rhythm, atrial fibrillation, right ventricular dysfunction, diastolic dysfunction, pulmonary artery hypertension (PAH), left atrium volume index (LAVI).

INTRODUCTION

Chronic heart failure with preserved left ventricular contractility is of great interest to the modern medical community, especially to cardiologists. This pathology is particularly remarkable for the involvement of the right ventricle in the pathological process, in the context of its systolic and diastolic dysfunction, and for the increase in morbidity, hospitalization, and mortality.

In chronic heart failure with preserved left ventricular function, the greatest concern is for the risk factors and comorbidities that exist in specific patients. Also of interest are the patients' age and gender, which are highly correlated with HFpE development. Numerous peer-reviewed

papers and articles have been devoted to these topics. For example, a study by Sacha Bhatia, which looked at the incidence of comorbidities and risk factors in HFpE patients, found that the majority of patients were over 75 years of age, mostly women (66%), and usually had arterial hypertension (55%). In addition, HFpEF patients were more likely to have diabetes mellitus and hyperlipidemia, and were more likely to smoke. It is worth noting that HFpEF, unlike HFrEF, where coronary and peripheral vascular disease predominate, has been associated with increased incidence of arrhythmias, especially atrial fibrillation [1].

One of the major pathological mechanisms for the development of chronic heart failure with preserved left ven-

tricular contractility is the loss of left ventricular contractility and so-called diastolic dysfunction. This process always leads to secondary remodeling of the left atrium, which in turn increases the risk of various arrhythmias, particularly atrial fibrillation. Available data suggest that atrial fibrillation occurs in 20–65% of patients with HFpEF [2]. Furthermore, HFpEF predominantly affects elderly individuals, who are more likely to have coexisting conditions that further increase the risk of atrial fibrillation [3].

In HFpEF patients with normal sinus rhythm, RV dysfunction occurs in approximately 31–53% of cases, whereas in patients with atrial fibrillation, the prevalence increases to 65–73% [2].

There are many theories as to the mechanism by which atrial fibrillation leads to worsening of right ventricular dysfunction in patients with HFpEF. Some researchers believe the simultaneous remodeling of the right atrium may explain this condition. Left atrial remodeling may also contribute to increased left ventricular pressure, reflected by the E/e' ratio and pulmonary artery pressure. Interestingly, in the Ulric Sartipy study, the incidence of atrial fibrillation in HFpEF patients was also explained by severe diastolic dysfunction and an increase in the left ventricular pressure, which in turn contributed to a pronounced remodeling of the left atrium and ultimately resulted in a high risk of AF. In support of this idea, the author noted that NT-proBNP levels were significantly higher in patients with HFpEF and AF [4]. This fact further supports the idea of left atrial fibrillation and pronounced remodeling.

Assaf Ben Arzi also discusses mechanisms of arrhythmia development in HFpEF patients in his work, focusing primarily on atrial fibrillation. According to the author, diastolic dysfunction of the left ventricle, increased left ventricular filling pressure, and left atrial remodeling are the main reasons that increase the risk of atrial fibrillation in this group [5].

Regarding NT-proBNP, Carolyn Lam's article states that the diagnostic value of this laboratory marker for verifying HFpEF in patients with AF should be assessed with caution, since it is not uncommon for patients to experience no subjective symptoms of HF despite an increase in NT-proBNP. The increase in this indicator is primarily due to the existing arrhythmia itself and pronounced left atrial remodeling. Therefore, the author calls for the use of additional diagnostic parameters, primarily the left atrial volumetric index (LAVi) [6].

Some studies suggest that in the setting of AF, the longitudinal contractile function of the right ventricle is more impaired. This concept is further supported by echocardiographic studies showing that restoration of sinus rhythm results in parallel improvement in parameters assessing RV longitudinal contractility [7]. Incidentally, Maja Cikes also named the cause of the predominant involvement of the RV in atrial fibrillation in HFpEF patients as its longitudinal contractility disorder [3].

Based on the above, in our patients, it would be interesting to assess whether there is a certain difference between the sizes and volumes of the right atrium, as well as

whether there is a higher rate of increase in left ventricular filling pressure in patients with HFpEF in two independent groups of sinus rhythm and atrial fibrillation.

MATERIALS AND METHODS

Characteristics of the study population

A prospective study, the aim of which was to study the involvement of the right ventricle according to the analysis of echocardiographic parameters in patients with chronic heart failure with preserved left ventricular contractile function in patients with sinus rhythm and atrial fibrillation separately and to compare the above data with each other, was conducted at David Agmashenebeli University of Georgia (DAUG) and Department of Cardiology of Jerarsi Clinic. During the study, data from 34 patients were analyzed, collected from January 2024 to December 2024.

The ethical issues of this study were discussed and approved by the Scientific Council of the DAUG. All patients involved in the study signed a consent form approved by the Scientific Council of the DAUG.

Chronic heart failure with preserved left ventricular ejection fraction (HFpEF) was confirmed in all patients by

1. The subjective and objective symptoms characteristic of HFpEF.
2. Identifying risk factors that contributed to the development of HFpEF.
3. The presence of a minimum of 4 and a maximum of 9 points of H2FpEF.
4. NT-proBNP testing, the target value of which in patients with sinus rhythm was ≥ 220 pg/ml and in patients with atrial fibrillation was ≥ 660 pg/ml. In all patients, the left ventricular (LV) ejection fraction (EF) was $\geq 50\%$.

The exclusion criteria for this study were as follows: refusal to sign the informed consent form, left ventricular ejection fraction $< 50\%$, inappropriate increase in NT-proBNP, other clear causes of NT-proBNP elevation, including (myocarditis, hypertrophic cardiomyopathy with or without outflow tract obstruction), myocardial trauma, pericardial diseases, severe infection, recent blood and blood component infusion, severe and critical anemia, severe liver cirrhosis, severe acquired heart disease, any type of congenital heart disease, acute cardiac or neurological problem (MI, angina, stroke) within 3 months prior to the study, coronary revascularization (PCI or CABG) within 3 months prior to the study, presence of an artificial heart valve, current and active viral hepatitis, active oncological disease, pathologies, terminal stage of chronic renal failure and acute renal failure, patients with any primary pathology that may affect the functional state of the right ventricle (severe COPD, bronchial asthma, pulmonary tuberculosis and other diseases of a specific nature, interstitial/inflammatory pathologies of the lungs of various causes, severe pulmonary fibrosis, oncological diseases of the lungs, acute pulmonary embolism or pulmonary hypertension developed against the background of chronic pulmonary embolism - CTEPH, severe sleep apnea syndrome), patients with unsatisfactory echocardiography

in whom it will be technically impossible to perform a cardiac ultrasound examination.

Patients were divided into two large groups: the first group included individuals with sinus rhythm, and the second group included patients with atrial fibrillation.

Demographic parameters were studied in all patients, including gender, age, height, weight, body mass index (BMI), and smoking status.

Laboratory studies included NT-proBNP, complete blood count, troponin, creatinine, eGFR, glycemic status, and iron levels (for patients with anemia). The study was conducted at the Jerarsi Clinic.

Electrocardiography was studied. The following parameters were measured in patients with sinus rhythm: heart rate, RR, PQ (PR), QRS, QT, and QTc. In patients with atrial fibrillation, heart rate, QRS, QT, and QTc parameters were studied.

All patients included in the study underwent a comprehensive cardiac ultrasound examination using the MIN-DRAY Resona I9. Linear measurements and volume estimation of cardiac chambers and vessels were performed according to the 2015 guidelines of the American Society of Echocardiography and the European Association of Cardiovascular Imaging: Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. The right ventricle was assessed using the 2010 Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography and the 2020 Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Practical Guideline from the British Society of Echocardiography, and other relevant literature and guidelines. Diastolic function was assessed according to the 2016 guidelines of the American Society of Echocardiography and the European Association of Cardiovascular Imaging: Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging.

The left ventricle was studied using the 17-segment method. Diastolic function was assessed using the fol-

lowing parameters: mitral pulse-wave Doppler (PW Doppler), mitral annulus tissue Doppler, deceleration time (DT), isovolumic relaxation time (IVRT), left atrial volume (LA volume) and volumetric index (LAVi), and tricuspid valve peak flow velocity (TR velocity).

The data of the right chambers, including the right ventricle, were evaluated using the following parameters: linear measurements of the right chambers and their volumes, fractional shortening area (FAC), tricuspid annular plane systolic excursion (TAPSE), tricuspid annular tissue S' peak (TDI RV S'), RV index of myocardial performance (RIMP), and Eccentric Index (EI). The following parameters were taken as indicators of the norm: FAC < 35%, RIMP > 0.54, TAPSE < 20 mm, RV S' < 10, and EI < 1.

Based on the obtained data, we drew the appropriate conclusions, which will be discussed in detail below.

Statistical analysis

Patients in this study were divided into two main groups: those with sinus rhythm and those with atrial fibrillation. The data from both groups were entered into a single, common table and then analyzed separately. To test the null hypothesis, the independent-samples Mann-Whitney U test was used.

To perform the comparative analysis, Levene's Test for Equality of Variances was used. According to this analysis, the estimated difference in the pro-BNP index between patients with sinus rhythm and those with atrial fibrillation was examined.

Correlation analysis was also performed between echocardiographic parameters of right ventricular systolic and diastolic dysfunction and pro-BNP, NYHA class of heart failure, and diastolic dysfunction parameters such as PCWP, E/e' ratio, and LAVi index, using the Pearson correlation test.

In statistical analysis, if P < 0.05, the data were reliable; if P > 0.05, the data were less reliable and unreliable.

RESULTS

Our study included 34 patients. Of these, 29 patients were female (85.3%), and 5 patients were male (14.7%) (table 1).

Table 1. Distribution of patients by gender

		Frequency	percent	valid percent	cumulative percent
Valid	Female	29	85.3	85.3	85.3
	Male	5	14.7	14.7	100.0
	Total	34	100.0	100.0	

Table 2. Distribution of patients by heart rhythm

		Frequency	percent	valid percent	cumulative percent
Valid	Sinus Rhythm	14	41.2	41.2	41.2
	Atrial fibrillation	20	58.8	58.8	100.0
	Total	34	100.0	100.0	

Table 3. Minimum, maximum, and average patient ages

N	Valid	34
	Missing	0
Mean	79.24	
Std. Deviation	8.557	
Minimum	52	
Maximum	91	

Table 4. Minimum, maximum, and average patient weights

N	Valid	34
	Missing	0
Mean	81.332	
Std. Deviation	14.1150	
Minimum	55.0	
Maximum	120.0	

Of these 34 patients, 14 (41.2%) had normal sinus rhythm, while 20 (58.8%) had atrial fibrillation. Accordingly, almost the same number of patients were included in the sinus rhythm and AFiB groups (table 2).

Based on the patients' data, their age and weight were studied. After analysis, the average age of the subjects in the study was 79 years ($M = 79.24$; $SD = 8.577$), with a minimum of 52 years and a maximum of 91 years (table 3).

Among the anthropometric indicators, attention was paid to patients' weight, which was necessary when summing the H2FPEF scores. Accordingly, the average weight of the subjects was 81 kg ($M = 81.33$; $SD = 14.11$), with a minimum of 55 kg and a maximum of 120 kg (table 4).

CLINICAL FEATURES

In the management of HFpEF, a significant emphasis is placed on the risk factors and comorbidities that markedly elevate the likelihood of developing this specific type of chronic heart failure. Throughout our research, we sought to determine whether there is a notable distinction in risk factors and comorbidities between patients with sinus rhythm and those with atrial fibrillation. To this end, we used specialized questionnaires distributed to study participants, along with a thorough examination of their medical records, which enabled us to gather extensive data on the presence of comorbidities. Below, we present a table that effectively illustrates the distribution of the most critical

comorbidities and risk factors among patients with sinus rhythm and those with atrial fibrillation (diagram 1).

Patients also completed a questionnaire related to the study, in which they documented symptoms and complaints experienced prior to their participation. Analysis of these symptoms was instrumental in accurately diagnosing HFpEF and in the proper evaluation of the H2FpEF scoring system. Based on the gathered information, it was intriguing to investigate whether there were any shared symptoms prevalent among patients with sinus rhythm and those with atrial fibrillation. Additionally, we noted certain distinctions between the subjects in these two groups, particularly regarding which symptoms were more indicative of one group than the other. Below is a compilation of the most frequently reported subjective and objective symptoms observed in individuals with sinus rhythm and atrial fibrillation (diagram 2).

LABORATORY CHARACTERISTICS

Given that pro-BNP serves as a crucial diagnostic laboratory marker for chronic heart failure characterized by preserved left ventricular contractile function, we examined its parameters across all patients. Our initial focus was on determining the maximum, minimum, and mean pro-BNP values, leading to the following findings. In patients with sinus rhythm, the minimum pro-BNP value was 475.40 pg/ml, and the maximum was 8528.61 pg/ml. Conse-

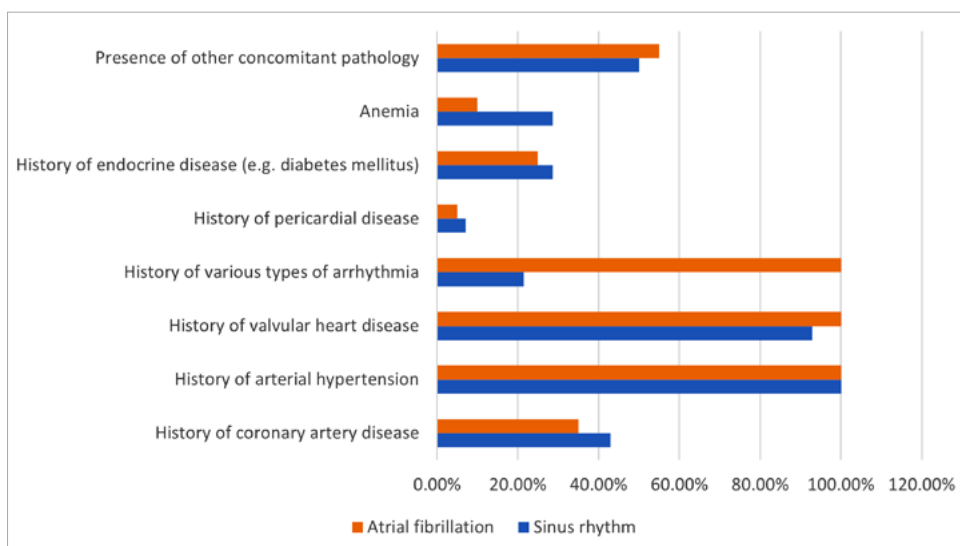


Diagram 1. The distribution of risk factors and comorbidities among patients exhibiting sinus rhythm and those with atrial fibrillation

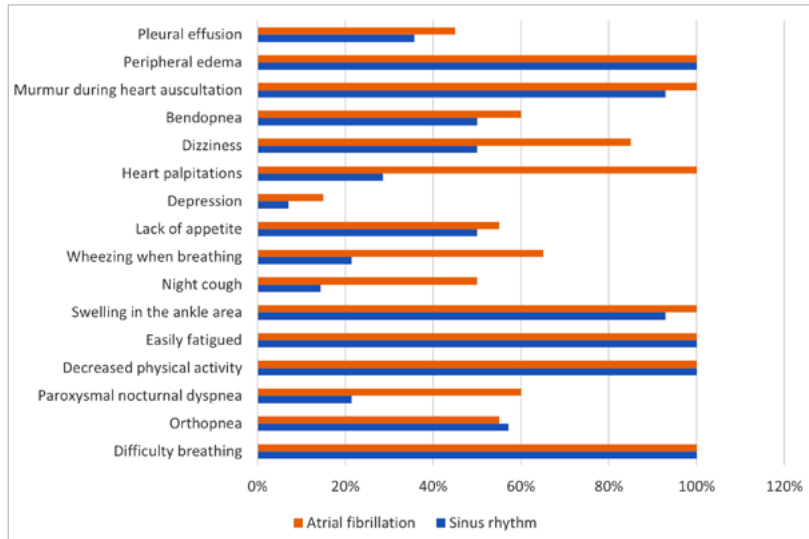


Diagram 2. The distribution of both subjective and objective symptoms among patients experiencing sinus rhythm and those with atrial fibrillation

Table 5. Minimum, maximum, and average pro-BNP levels observed in patients exhibiting sinus rhythm and those with atrial fibrillation

NT-proBNP (pg/ml)			
Sinus rhythm	N	Valid	14
		Missing	0
	Mean	2428.9643	
	Std. Deviation	2262.85817	
	Maximum	7671.90	
Atrial fibrillation	N	Valid	19
		Missing	1
	Mean	6571.1084	
	Std. Deviation	8528.61693	
	Maximum	35000.00	
<i>t</i> statistics - 2.07039, <i>p</i> -value - 0.04982			

quently, we calculated the mean value to be 2428 pg/ml (M = 2428.96; SD = 2262.85).

In patients diagnosed with atrial fibrillation, the minimum pro-BNP level recorded was 1274 pg/ml, while the maximum reached 8528.61 pg/ml. Consequently, the av-

erage pro-BNP level was calculated to be 6571.10 pg/ml (M = 6571.10; SD = 8528.61) (table 5).

It was intriguing to examine the degree of difference in pro-BNP increase between patients in the sinus rhythm and atrial fibrillation groups. The correlation analysis indicated no statistically significant difference in this variable between the two groups (P = .056). However, it is important to note that individuals with atrial fibrillation showed a greater increase in pro-BNP than those with sinus rhythm (table 6).

ECHOCARDIOGRAPHIC FEATURES

As previously mentioned in the literature review, the likelihood of developing atrial fibrillation in patients with HFpEF is heightened by several significant factors, including diastolic dysfunction, elevated left ventricular pressure, and left atrial remodeling. Conversely, alterations associated with HFpEF, particularly impaired diastolic function and left atrial remodeling, may contribute to the onset of AFib. In light of this perspective, it was pertinent to investigate the frequency of diastolic dysfunction parameters and elevated left ventricular filling pressure, including pulmonary capillary wedge pressure (PCWP), the increased

Table 6. Variations in pro-BNP levels between patients exhibiting sinus rhythm and those with atrial fibrillation

NT-proBNP (pg/ml)		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
NT-proBNP (pg/ml)	Equal variances assumed	6.883	.013	-1.765	31	.087	-4142.14414	2346.49165	-8927.84541	643.55714
	Equal variances not assumed			-2.023	21.334	.056	-4142.14414	2047.93341	-8396.99743	112.70916

E/e' ratio, and the augmented left atrial volumetric index (LAVi), within our study population. Additionally, we sought to determine whether there was a more distinct and specific variation in the aforementioned echocardiographic parameters between two independent cohorts: individuals in sinus rhythm and those with atrial fibrillation.

PCWP was determined using the equation $PWCP = 1.24 \times (E/e') + 1.9$, where E represents the peak height of the E wave measured by transmitral PW Doppler, and e' denotes the average values of the septal e' and lateral e' parameters acquired through tissue Doppler assessment of the mitral annulus. The standard PCWP threshold was set at <15 mmHg. Furthermore, the mean values of E and e' were utilized to approximate the filling pressure of the left ventricles when the normal E/e' ratio was ≤ 9 .

Consequently, the analysis of these parameters indicated that among 14 individuals with sinus rhythm, 9 patients demonstrated elevations in both the PCWP and E/e' ratio, suggesting an increase in left ventricular filling pres-

sure (64.3%). Conversely, 5 patients (35.7%) were found not to exhibit this issue (table 7).

Among the 20 participants categorized within the atrial fibrillation group, an elevation in PWCP and E/e' ratio, leading to left ventricular enlargement, was noted in 17 instances (85%), whereas the existence of the previously mentioned issue was refuted in merely 3 instances (15%) (table 8).

The left atrial volumetric index (LAVi) is an independent risk factor for the onset of atrial fibrillation. It is evident that, in the context of HFpEF, with left atrial remodeling and a corresponding rise in LAVi, the likelihood of developing this arrhythmia significantly increases, a point we have elaborated on previously. Conversely, atrial fibrillation, which is frequently considered a primary contributor to HFpEF, can also lead to left atrial remodeling and an increase in LAVi.

In our research, we aimed to determine which group predominantly showed an increase in LAVi and by how

Table 7. The rate at which left ventricular filling pressure rises in individuals exhibiting sinus rhythm

AF * Filling cavities Crosstabulation					
			Filling cavities		Total
			Elevated left ventricular filling pressure has not been observed	Elevated left ventricular filling pressure has been observed	
AF	Sinus rhythm	Count	5	9	14
		Expected Count	3.3	10.7	14.0
		% within AF	35.7%	64.3%	100.0%
	Atrial fibrillation	Count	3	17	20
		Expected Count	4.7	15.3	20.0
		% within AF	15.0%	85.0%	100.0%
Total	Count	8	26	34	
	Expected Count	8.0	26.0	34.0	
	% within AF	23.5%	76.5%	100.0%	

As per Fisher's analysis, the P value was determined to be 0.1611, indicating a lack of statistical significance

Table 8. The rate at which left ventricular filling pressure rises in individuals diagnosed with atrial fibrillation

AF * Filling cavities Crosstabulation					
			Filling cavities		Total
			Elevated left ventricular filling pressure has not been observed	Elevated left ventricular filling pressure has been observed	
Atrial fibrillation	Count	3	17	20	
	Expected Count	4.7	15.3	20.0	
	% within AF	15.0%	85.0%	100.0%	
Total	Count	8	26	34	
	Expected Count	8.0	26.0	34.0	
	% within AF	23.5%	76.5%	100.0%	

As stated by Fisher, the P value was recorded at 0.3507, indicating a lack of significance

much. The normal range for LAVi was established as < 34 ml/m². A mild increase was classified as 34–41 ml/m²; a LAVi measurement of 42–48 ml/m² was deemed moderately elevated, while values exceeding 48 ml/m² were categorized as markedly elevated. Based on these criteria, among 14 patients with sinus rhythm, LAVi remained within normal limits for 7 individuals (50%), whereas the remaining 7 patients (50%) exhibited elevated levels; within this group, a mild increase in LAVi was noted in 3 patients (21.4%), a moderate increase was identified in 2 patients (14.3%), and a significant increase was also recorded in 2 patients (14.3%) (table 9).

Regarding the 20 individuals diagnosed with atrial fibrillation, we obtained varied responses: only 1 patient had a normal LAVi (5%). Among the individuals assessed,

LAVi was slightly elevated in 7 patients (35%), moderately elevated in 4 patients (20%), and substantially elevated in 8 patients (40%) (table 10).

The primary objective of the research was to determine the extent to which deviations from the normative values of right ventricular dysfunction parameters were more pronounced in patients with sinus rhythm than in those with atrial fibrillation. Our focus was on identifying the parameter that most accurately indicated right ventricular dysfunction, regardless of the subject's group. Additionally, we sought to explore the relationship between echocardiographic parameters of right ventricular dysfunction and the characteristics of the rhythm. To achieve this, we examined indicators that reflect the functional status of the right ventricle, including FAC, TAPSE, RIMP, and S_v.

Table 9. LAVi measurement in individuals exhibiting sinus rhythm

AF * LAVi_Groups Crosstabulation			LAVi_Groups				Total
			Normal	Slight enhancement	Moderate enhancement	Significant enhancement	
AF	Sinus rhythm	Count	7	3	2	2	14
		Expected Count	3.3	4.1	2.5	4.1	14.0
		% within AF	50.0%	21.4%	14.3%	14.3%	100.0%

Table 10. LAVi measurement in individuals exhibiting atrial fibrillation

AF * LAVi_Groups Crosstabulation			LAVi_Groups				Total
			Normal	Slight enhancement	Moderate enhancement	Significant enhancement	
Atrial fibrillation		Count	1	7	4	8	20
		Expected Count	4.7	5.9	3.5	5.9	20.0
		% within AF	5.0%	35.0%	20.0%	40.0%	100.0%

The analysis revealed that FAC had the lowest specificity for indicating right ventricular dysfunction in patients from both groups. A reduction in FAC to below 35% was observed in only 2 of 34 patients, with 1 in the sinus rhythm group and 1 in the atrial fibrillation group (table 11).

In the context of TAPSE, a reduction in this measurement (<20 mm) was observed in 20 of 34 patients (50.8%). Among the 14 patients with sinus rhythm, 6 (42.9%) had a decline in TAPSE below the relevant threshold. Conversely,

within the group of 20 patients diagnosed with atrial fibrillation, a decrease in this metric was recorded in 14 patients (70%) (table 12).

While analyzing S_v, we observed a reduction (< 10 cm/s) in 11 patients, representing 32.4% of the total 34 patients. Furthermore, 4 cases (28.6%) were identified within the sinus rhythm group, while 7 patients (35%) were categorized in the atrial fibrillation group (table 13).

Table 11. The rate at which FAC decreases in patients from both groups

AF * FAC_1 Crosstabulation					
			FAC_1		Total
			Normal	Decreased	
AF	Sinus rhythm	Count	13	1	14
		% within AF	92.9%	7.1%	100.0%
	Atrial fibrillation	Count	19	1	20
		% within AF	95.0%	5.0%	100.0%
Total		Count	32	2	34
		% within AF	94.1%	5.9%	100.0%

As stated by Fisher, the P value was recorded at 0.6613, indicating a lack of statistical significance

Table 12. The rate at which FAC decreases in patients from both groups

AF * TAPSE_1 Crosstabulation					
			TAPSE_1		Total
			Normal	Decreased	
AF	Sinus rhythm	Count	8	6	14
		% within AF	57.1%	42.9%	100.0%
	Atrial fibrillation	Count	6	14	20
		% within AF	30.0%	70.0%	100.0%
Total		Count	14	20	34
		% within AF	41.2%	58.8%	100.0%

As stated by Fisher, the P value was recorded at 0.1097, indicating a lack of statistical significance

Table 13. The rate at which S[∞] decreases in patients from both groups

AF * S ₁ Crosstabulation		S ₁		Total	
		Normal	Decreased		
AF	Sinus rhythm	Count	10	4	14
		% within AF	71.4%	28.6%	100.0%
	Atrial fibrillation	Count	13	7	20
		% within AF	65.0%	35.0%	100.0%
Total		Count	23	11	34
		% within AF	67.6%	32.4%	100.0%

Fisher reported a P value of 0.4945, indicating that it was not statistically significant

Table 14. The rate at which RIMP decreases in patients from both groups

AF * RIMP ₁ Crosstabulation		RIMP ₁		Total	
		Normal	Decreased		
AF	Sinus rhythm	Count	2	12	14
		% within AF	14.3%	85.7%	100.0%
	Atrial fibrillation	Count	5	15	20
		% within AF	25.0%	75.0%	100.0%
Total		Count	7	27	34
		% within AF	20.6%	79.4%	100.0%

As stated by Fisher, the P value was 0.3775, indicating that it was not statistically significant

Regarding the rise in RIMP (>0.54), it was observed in 27 of the 34 individuals assessed (79.4%). Furthermore, among the 14 patients in sinus rhythm, deviations from the standard for this parameter were identified in 12 cases (85.7%), whereas in the group of 20 patients with atrial fibrillation, deviations were observed in 15 cases (75%) (table 14).

Upon further examination of the distribution of FAC, TAPSE, RIMP, and S[∞] deviations from the normative values in individuals exhibiting sinus rhythm and those with atrial fibrillation, we can identify the following response patterns: Deviations in FAC from the norm were noted equally, at 50%, in both cohorts, although such deviations were the least frequently observed. Regarding TAPSE, deviations from the norm were present in 30% of patients with sinus rhythm, while 70% of subjects in the atrial fibrillation cohort exhibited such deviations. Deviations in S[∞] from the norm were identified in 36.4% of individuals with sinus rhythm and in 63.6% of those with atrial fibrillation. Regarding RIMP, deviations from the norm were observed in 44.4% of individuals with sinus rhythm and 55.6% with atrial fibrillation (table 15).

When discussing right ventricular dysfunction, it is essential to examine not only the echocardiographic parameters previously highlighted but also the right ventricular dimensions and volumes. These parameters were similarly assessed in our study participants. We specifically focused on the basal right ventricular size in the apical 4-chamber view, with a normative value of < 41 mm, irrespective of gender. By analyzing data from 34 patients, we found that the basal right ventricular size was elevated in 7 individuals (20.6%). Among these, 1 patient was categorized in the sinus rhythm group (7.1%), while 6 individuals were categorized in the atrial fibrillation group (30%) (table 16).

We also examined right ventricular end-diastolic volume, with normal values < 44 ml in men and < 36 ml in women. Our focus was on the extent of right ventricular dilatation in both groups of participants. The findings were as follows: in a cohort of 29 female patients, 14 instances (48.3%) of right ventricular dilatation were noted, irrespective of heart rhythm, whereas in the male group, this number was 5 (100%) (table 17).

Table 15. Deviation from the standard of TAPSE, S[∞], FAC, and RIMP observed in patients from both groups

Impaired contractile function of the right ventricle Crosstabulation			AF		Total
			Sinus rhythm	Atrial fibrillation	
Impaired contractile function of the right ventricle	FAC ₁	n	1	1	2
		%	50.0%	50.0%	
	RIMP ₁	n	12	15	27
		%	44.4%	55.6%	
	TAPSE ₁	n	6	14	20
		%	30.0%	70.0%	
	S ₁	n	4	7	11
		%	36.4%	63.6%	
Total		n	13	19	32

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Fisher reported that the P value for the FAC parameter was 0.6667, indicating a lack of significance. Fisher indicated that the P value for the RIMP parameter was 0.5011, which was also not significant. Fisher noted that the P value for the TAPSE parameter was 0.3003, demonstrating no significance. Fisher stated that the P value for the S[∞] parameter was 0.5331, which did not reach significance.

Table 16. Deviation from the standard size of the right ventricle in individuals from both groups

AF * Basalsize_Groups Crosstabulation					
			Basalsize_Groups		Total
			Normal	Decreased	
AF	Sinus rhythm	Count	13	1	14
		% within AF	92.9%	7.1%	100.0%
	Atrial fibrillation	Count	14	6	20
		% within AF	70.0%	30.0%	100.0%
Total		Count	27	7	34
		% within AF	79.4%	20.6%	100.0%

Fisher reported a P value of 0.1153, indicating that it was not statistically significant

Table 17. Deviation from the standard of RVEDV observed in patients from both groups

RVED_Gender						
Gender			Frequency	Percent	Valid Percent	Cumulative Percent
Female	Valid	Normal	15	51.7	51.7	51.7
		Right ventricular dilatation	14	48.3	48.3	100.0
		Total	29	100.0	100.0	
Male	Valid	Right ventricular dilatation	5	100.0	100.0	100.0

As per Fisher's analysis, the P value was determined to be 0.05572, which is near the threshold of confidence

In general, when examining deviation of RVEDV from the norm in patients with sinus rhythm compared to those with atrial fibrillation, the following conclusion can be drawn: right ventricular dilatation was observed in 42.9% of patients in the sinus rhythm cohort and in 65% of patients with atrial fibrillation (table 18).

The focus of our research was right atrial dilatation, a significant aspect of overall right ventricular remodeling and dysfunction. The standard volume of the right atrium was found to be less than 18 cm² for both genders. Consequently, based on the data analysis, we concluded that right atrial dilatation was identified in 22 of the 34 individuals assessed (64.7%). Within this group, 6 patients were classified as having sinus rhythm (42.9%), while 16 patients were categorized under the atrial fibrillation group (80%) (table 19).

Ultimately, right ventricular dysfunction in individuals with HFpEF is typically linked to pulmonary hypertension, which in turn often plays a role in the emergence of symp-

toms associated with chronic heart failure, including shortness of breath and breathing difficulties, among others. Our objective was to assess the presence and severity of pulmonary hypertension in patients from both cohorts. To achieve this, we evaluated mean pulmonary arterial pressure (mPAP), with a normative value set at <20 mmHg. A mPAP ranging from 20 to 40 mmHg indicated mild pulmonary hypertension; a range of 41 to 55 mmHg was classified as moderate hypertension, while a mPAP exceeding 55 mmHg was deemed severe pulmonary hypertension.

Based on the aforementioned findings, among the 14 patients in the sinus rhythm cohort, only 1 (7.1%) exhibited normal pulmonary pressure, whereas mild hypertension was identified in 13 (92.9%). In the group of 20 patients with atrial fibrillation, pulmonary hypertension was noted in 16 individuals (80%). Within this subgroup, moderate hypertension was observed in 3 cases (15%), and severe hypertension was present in 1 case (5%) (table 20, 21).

Table 18. The deviation of RVEDV from the standard in individuals exhibiting sinus rhythm and those with atrial fibrillation, considered separately.

AF * RVED_Gender Crosstabulation					
			RVED_Gender		Total
			Normal	Decreased	
AF	Sinus rhythm	Count	8	6	14
		% within AF	57.1%	42.9%	100.0%
	Atrial fibrillation	Count	7	13	20
		% within AF	35.0%	65.0%	100.0%
Total		Count	15	19	34
		% within AF	44.1%	55.9%	100.0%

Fisher reported that the P value was 0.1766, indicating a lack of significance

Table 19. The distribution of right atrial dilation among patients in both groups

AF * RAcm_Groups Crosstabulation					
			RAcm_Groups		Total
			Normal	Right atrial dilatation	
AF	Sinus rhythm	Count	8	6	14
		% within AF	57.1%	42.9%	100.0%
	Atrial fibrillation	Count	4	16	20
		% within AF	20.0%	80.0%	100.0%
Total		Count	12	22	34
		% within AF	35.3%	64.7%	100.0%

As stated by Fisher, the P value was 0.03106, indicating a clear level of significance

Table 20. The prevalence of pulmonary hypertension among individuals exhibiting sinus rhythm

AF * Mpap_Groups Crosstabulation			Mpap_Groups				Total
			Normal	Mild	Moderate	Severe	
AF	Sinus rhythm	Count	1	13	0	0	14
		% within AF	7.1%	92.9%	0.0%	0.0%	100.0%

Table 21. The prevalence of pulmonary hypertension among individuals exhibiting atrial fibrillation

AF * Mpap_Groups Crosstabulation			Mpap_Groups				Total
			Normal	Mild	Moderate	Severe	
	Atrial fibrillation	Count	0	16	3	1	20
		% within AF	0.0%	80.0%	15.0%	5.0%	100.0%

DISCUSSION

The involvement of the right ventricle in patients suffering from chronic heart failure with preserved left ventricular function is a significant issue that has garnered considerable interest from the scientific community. Among the various factors contributing to the onset of HFpEF, atrial fibrillation is prominent. Furthermore, it is important to highlight that individuals with HFpEF face an elevated risk of developing AFib, particularly due to the presence of left atrial remodeling and dilation.

The degree to which the right ventricle participates in the pathological mechanisms of HFpEF, the manner in which its dysfunction is reflected through deviations from standard echocardiographic metrics, and the identification of secondary indicators of RV dysfunction, particularly pulmonary hypertension, constituted the primary aims and inquiries of our research. Additionally, we sought to determine whether there were variations in these parameters between two distinct cohorts: individuals with sinus rhythm and those with atrial fibrillation.

To tackle these pertinent questions, we analyzed all significant echocardiographic metrics indicative of right ventricular dysfunction, such as TAPSE, RIMP, S', and FAC. We investigated the occurrence of pulmonary hypertension and utilized the highly sensitive measure of mean pulmonary arterial pressure (mPAP) to address this concern.

Furthermore, we examined critical comorbidities associated with HFpEF, including diastolic dysfunction, elevated left ventricular filling pressure, left atrial enlargement, and left ventricular volumetric index, to assess their prevalence among HFpEF patients and their distribution across different cardiac rhythms. Consequently, our objective was to determine whether there is a significant difference in the aforementioned parameters between patients with HFpEF who present with sinus rhythm and those who present with atrial fibrillation.

CONCLUSION

A total of 34 patients were categorized into two distinct groups. Among these, 14 patients were assigned to

the sinus rhythm group, and 20 to the atrial fibrillation group. Through the analysis of their outcomes, we initially identified that the primary risk factor, which is crucial in the onset of HFpEF, irrespective of heart rhythm characteristics, is arterial hypertension (observed in 100% of cases across both groups) along with a history of valvular heart disease (92.9% in individuals with sinus rhythm and 100% in those with atrial fibrillation). For evident reasons, a history of arrhythmia was presented in 100% of cases among individuals with atrial fibrillation. Notably, Ulrik Sartipy, who examined the occurrence of AF in patients suffering from chronic heart failure with both preserved and reduced left ventricular contractile function, noted that this type of rhythm disorder is found in 21 to 65% of patients with HFpEF, which is significantly higher than the prevalence of the same arrhythmia in patients with HFrEF, which ranges from less than 10% to 50% [x].

Interestingly, age, a primary criterion for diagnosing H2FpEF, significantly contributed to the progression of this condition, irrespective of heart rhythm: advanced age (>60 years) was observed in 92.9% of cases in the sinus rhythm cohort and in 100% of those with atrial fibrillation.

Upon reviewing the diagnostic criteria for H2FpEF, it was also found that severe arterial hypertension, necessitating the administration of two or more antihypertensive medications, was present in 92.9% of individuals exhibiting sinus rhythm and in 100% of those with atrial fibrillation.

The prevalence of pulmonary hypertension (PASP > 35 mmHg as determined by Doppler) and elevated left ventricular filling pressure ($E / e' > 9$ as measured by Doppler) was markedly higher in both cohorts: 85.7% and 78.6% among individuals with sinus rhythm and 80% and 90% among those with atrial fibrillation, respectively (table 22).

We received a noteworthy response regarding the pro-BNP index, revealing that an elevation in this crucial laboratory marker of heart failure was observed in both cohorts; however, it was more pronounced in patients with concurrent atrial fibrillation.

The left ventricular filling pressure was assessed by calculating the ratio of the pulmonary capillary wedge

Table 22. The allocation of diagnostic criteria for H2FpEF among patients in both groups

H2FpEF_Criteria Crosstabulation		H2FpEF_Criteria						Total	
		Excess weight (Heavy) 2 point	Severe hypertension (Hypertensive) 1 point	Atrial Fibrillation (Atrial Fibrillation) 3 point	Pulmonary Hypertension (Pulmonary Hypertension) 1 point	Adult age (Elder) 1 point	Filling Pressure (Filling Pressure) 1 point		
AF	Sinus rhythm	Count	6	13	3	12	13	11	14
		% within AF	42.9%	92.9%	21.4%	85.7%	92.9%	78.6%	
	Atrial fibrillation	Count	7	20	20	16	20	18	20
		% within AF	35.0%	100.0%	100.0%	80.0%	100.0%	90.0%	
Total		Count	13	33	23	28	33	29	34

Percentages and totals are based on respondents

a. Dichotomy group tabulated at value 1

pressure (PCWP) to the average of the transmitral E peak and the mitral annulus e` peaks. Based on PCWP and E/e', an increase in left ventricular filling pressure was identified in 64.3% of patients with sinus rhythm (9 patients) and in 85% of patients with atrial fibrillation (17 patients). Thus, it is evident that PCWP is a vital indicator of rising left ventricular filling pressure, and this parameter is more frequently elevated in individuals with AFib.

The phenomenon of left atrial remodeling was examined meticulously, with the primary focus being the left atrial volumetric index (LAVi), which was ultimately analyzed at the conclusion of the study. In subjects with sinus rhythm, left atrial dilatation and remodeling were identified in 50% of cases, whereas in those with atrial fibrillation, this percentage rose to 94.7% (19 cases). It is also important to highlight that among individuals with atrial fibrillation, moderate to severe instances of left atrial dilatation/remodeling were predominantly noted, while only 35% exhibited mild abnormalities. In contrast, among individuals maintaining sinus rhythm, the occurrence of pronounced dilatation/remodeling was significantly lower, at 14.3%. Consequently, the hypothesis suggesting that left atrial dilatation/remodeling is more pronounced in patients with HFpEF when atrial fibrillation is present has been substantiated.

A noteworthy conclusion regarding this matter is presented in an article by Dipak Kotecha, who examined the prevalence of atrial fibrillation (AF) in patients with heart failure with preserved ejection fraction (HFpEF). In patients exhibiting this arrhythmia, a marked elevation in NT-proBNP levels, significant left atrial enlargement, and pronounced diastolic dysfunction were frequently noted; furthermore, the predominant demographic consisted of older adults [xi]. Consequently, the genuine correlation observed in our research regarding atrial remodeling, elevated left ventricular filling pressure, and the frequency of atrial fibrillation in patients with HFpEF has similarly been recognized by other scholars.

Regarding the echocardiographic indicators of the functional condition of the right ventricle, we concentrated on TAPSE, FAC, S`, RIMP, and the parameter for pulmonary hypertension, specifically mPAP.

Regarding FAC, our findings indicated that this parameter showed the least variation, suggesting RV dysfunction in both groups. Although pathological alterations in FAC were noted in 50% of patients within each group, deviations from the normal range were only identified in one patient from the sinus rhythm group and one patient experiencing atrial fibrillation. Thus, FAC should not be regarded as a specific echocardiographic marker of RV dysfunction in either patient group.

Regarding TAPSE, which primarily assesses the longitudinal contractile function of the right ventricle, we observed notably different results. Specifically, a reduction in TAPSE was found in patients from both groups, with this parameter being predominantly affected in patients with atrial fibrillation (70%). Consequently, evaluating RV contractility along the longitudinal axis and, by extension, calculating TAPSE can be deemed a significant diagnostic criterion for investigating RV dysfunction, particularly in individuals with AFib.

The reduction in the S` parameter did not show significant diagnostic value, as a decrease was observed in only 28.6% of individuals with sinus rhythm and 35.0% with atrial fibrillation.

Regarding RIMP, a parameter that reflects both systolic and diastolic function of the right ventricle, an increase was observed at nearly identical frequencies in both cohorts: 44.4% among individuals with sinus rhythm and 55.6% among those with atrial fibrillation. Notably, the rise in RIMP was similarly observed with almost equivalent frequency, irrespective of whether the patient maintained a normal sinus rhythm or experienced atrial fibrillation: 85.7% and 75%, respectively. This suggests that RIMP serves as a definitive indicator of right ventricular dysfunction, independent of the patient's rhythm type.

The assessment of right ventricular dilatation involved calculating RV basal size and RVEDV. Our findings indicate that the basal size of the right ventricle may remain within the normal limits, irrespective of any impairment in its systolic and/or diastolic function, as evidenced by parameters such as FAC and TAPSE. Consequently, the basal size of the right ventricle does not serve as a reliable indicator of its functional status across demographic groups. Mea-

asuring the right ventricular volume was a considerable challenge, given that normal RVEDV values differ between males and females. Since the majority of participants in our study were female (29 women and 5 men), a thorough gender-based analysis of this parameter was unfeasible. Furthermore, among the female participants, RVEDV values were nearly evenly distributed between normal and pathological ranges, at 51.7% and 48.3%, respectively, whereas all five male participants (100%) exhibited pathological RVEDV values.

Concerning right atrial dilatation, it was relatively straightforward to reach conclusions, as the normative value for this parameter is identical for both men and women (< 18 cm²). Consequently, upon analyzing the data, we found that right atrial dilatation occurs in the majority of HFpEF cases (64.7%) and, among those with atrial fibrillation, it was observed more frequently (80% of cases).

In our investigation of pulmonary hypertension, we observed that the condition developed in nearly all patients, irrespective of rhythm disturbances: 92.9% in sinus rhythm and 100% in atrial fibrillation. Notably, moderate hypertension was more prevalent among individuals with atrial fibrillation (15.0%). In contrast, moderate hypertension was absent in patients with sinus rhythm, with all issues in this group being limited to mild pulmonary hypertension.

In conclusion, our research allows us to establish the following points: 1. The primary factors contributing to HFpEF are arterial hypertension, older age, atrial fibrillation, and acquired valvular diseases. 2. An elevation in left ventricular filling pressure is noted in both patient groups with HFpEF, although this is more closely linked to

the concurrent presence of AFiB. Furthermore, patients with AFiB frequently experience issues related to left atrial enlargement/remodeling, which is predominantly indicated by an increase in the LAVi index. 3. Among the echocardiographic indicators of right ventricular dysfunction, including TAPSE, S', RIMP, and FAC, FAC is the least informative, as its reduction is rarely observed, irrespective of the patient's heart rhythm. TAPSE, which assesses RV longitudinal contractile function, shows a decrease in both patient groups, though it is more pronounced in AFiB. S' does not serve as a significant diagnostic marker, given that its reduction is seen in a limited number of patients, regardless of heart rhythm. RIMP stands out as the most informative parameter indicative of RV dysfunction, increasing with nearly equal frequency, irrespective of whether sinus rhythm or atrial fibrillation is present. 4. Right atrial enlargement is a crucial marker of right ventricular dysfunction in patients with HFpEF, particularly in the context of AFiB. 5. Pulmonary hypertension, recognized as a concomitant symptom of right-sided dysfunction, is present in all patients with HFpEF alongside AFiB and is frequently observed in those with sinus rhythm. Additionally, AFiB is more closely associated with mild hypertension compared to sinus rhythm.

BASIC LIMITATIONS

The study's predominant patient demographic was female; therefore, a detailed analysis of the data stratified by gender would be unreliable.

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მარცხენა პარკუჭის შენახული კუმშვადი ფუნქციით მიმდინარე გულის ქრონიკული უკმარისობა პაციენტებში სინუსური რიტმის და წინაგულთა ფიბრილაციის დროს

(რისკ-ფაქტორების, სიმპტომების, ლაბორატორიული მაჩვენებლების და მარჯვენა პარკუჭის დისფუნქციის ექოკარდიოგრაფიული პარამეტრების შედარება)

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რეზიუმე გულის ქრონიკული უკმარისობა მარცხენა პარკუჭის შენახული კუმშვადი ფუნქციით, თანამედროვე სამედიცინო საზოგადოებისთვის და უპირატესად კარდიოლოგებისთვის დიდი ინტერესის საგანს წარმოადგენს. მარცხენა პარკუჭის შენახული კუმშვადი ფუნქციით მიმდინარე გულის ქრონიკული უკმარისობის დროს, მნიშვნელოვან ენიჭება იმ რისკ-ფაქტორებს და თანდართულ დაავადებებს, მათ შორის წინაგულთა ფიბრილაციას, რაც ქმნის HFpEF - ის განვითარების საფუძველს. მარჯვენა პარკუჭის ჩართულობა HFpEF პაციენტებში ერთ-ერთი საყურადღებო პრობლემაა. RV - ის დისფუნქციას უკავშირდება არა მარტო კლინიკური გამოვლინების და გულის უკმარისობის ხარისხის სიმძიმე, არამედ დაავადების სამომავლო პროგნოზი და გამოსავალი.

იქიდან გამომდინარე, რომ წინაგულთა ფიბრილაციას საკუთარი, უდიდესი წვლილი შეაქვს არა მარტო HFpEF - ის განვითარებაში, არამედ პროცესში მეორადად RV - ის ჩართულობის საკითხში, საინტერესო იქნება დადგინდეს სიმპტომებს, რისკ-ფაქტორებს, ლაბორატორიული და ინსტრუმენტული კვლევების პასუხებს შორის არსებული ის სავარაუდო განსხვავება, რაც შესაძლებელია არსებობდეს პაციენტებში სინუსური რიტმის და წინაგულთა ფიბრილაციის ფონზე.

მეთოდები: ჩვენ გამოვიკვლიეთ 34 პაციენტი, რომლებსაც დადგინდათ ჰქონდათ გულის ქრონიკული უკმარისობა მარცხენა პარკუჭის შენახული კუმშვადი ფუნქციით. პაციენტები დაგვავით ორ დამოუკიდებელ ჯგუფად გულის რიტმის თავისებურების მიხედვით: სინუსური რიტმი და წინაგულთა ფიბრილაცია. მონაცემები შესწავლილი იყო სათითაოდ ორ განსხვავებულ ჯგუფში და შემდგომში მოხდა აღნიშნული შედეგების შედარება. ჩვენი ინტერესის საგანს წარმოადგენდა ყველა ის ძირითადი რისკ-ფაქტორი და თანდართული დაავადება, რაც საფუძვლად ედო HFpEF - ის განვითარებას, ასევე დიასტოლური დისფუნქციის პარამეტრები, გამოვლენილი პულმონური კაპილარული ჩაჭედვის წნევის (PCWP) და E/e` თანაფარდობის მატებით, მარცხენა წინაგულის მოცულობითი ინდექსის (LAVi) ზრდით. ჩვენს ასევე შევისწავლეთ მარჯვენა პარკუჭის ფუნქციური მდგომარეობა და პულმონური ჰიპერტენზიის არსებობა და მისი ხარისხი ისეთი ექოკარდიოგრაფიული პარამეტრების გამოყენებით, როგორც არის მარჯვენა პარკუჭის ფრაქციული დამოკლების ფართობი (FAC), მარჯვენა პარკუჭის მოკარდიუმის დამყოლობის ინდექსი (RIMP), სამკარიანი სარქველის რგოლის სისტოლური ექსპურსიის გამოთვლა (TAPSE), სამკარიანი რგოლის ექსპურსიის ქსოვილოვანი S` პიკი, საშუალო პულმონური წნევა (mPAP). ორი ჯგუფის პაციენტებისგან მიღებული მონაცემები საბოლოოდ შევადარეთ ერთმანეთს.

დასკვნა: 1. HFpEF - ის მთავარ ხელშემწყობ ფაქტორთა შორის ყველაზე ხშირად ვლინდება არტერიული ჰიპერტენზია, მოზრდილი ასაკი, წინაგულთა ფიბრილაცია და შეძენილი სარქველოვანი პათოლოგიები. 2. მარცხენა ღრუების ავსების წნევის მატება შეინიშნება ორივე ჯგუფის პაციენტში HFpEF - ის დროს, თუმცა ეს გარემოება მეტად უფრო ასოცირებულია AFib - ის პარალელური არსებობასთან. 3. მარჯვენა პარკუჭის დისფუნქციის ექოკარდიოგრაფიულ პარამეტრებს შორის, ყველაზე ნაკლებ ინფორმატიული გახლავთ FAC. TAPSE ქვეითდება ორივე ჯგუფის პაციენტში, თუმცა უპირატესად AFib - ის ფონზე. S` არ გახლავთ მნიშვნელოვანი სადიაგნოსტიკო მარკერი, რადგან მისი კლება ვლინდება პაციენტების მცირე პოპულაციაში. RIMP წარმოადგენს RV - ის დისფუნქციის ამსახველ ყველაზე ინფორმატიულ პარამეტრს, რომელიც თითქმის ერთნაირი სიხშირით იზრდება, მიუხედავად სინუსური რიტმისა თუ წინაგულთა ფიბრილაციის არსებობისა. მარჯვენა წინაგულის დილატაცია მარჯვენა ღრუების დისფუნქციის ერთ-ერთი მნიშვნელოვანი მარკერია HFpEF პაციენტებში, განსაკუთრებით AFib - ის არსებობის ფონზე. პულმონური ჰიპერტენზია, როგორც მარჯვენამხრივი დისფუნქციის ერთ-ერთი თანმდევი სიმპტომი ვლინდება ყველა პაციენტში HFpEF დროს AFib - ის არსებობის პარალელურად.

საკვანძო სიტყვები: გულის ქრონიკული უკმარისობა მარცხენა პარკუჭის შენახული კუმშვადი ფუნქციით (HFpEF), სინუსური რიტმი, წინაგულთა ფიბრილაცია, მარჯვენა პარკუჭის დისფუნქცია, დიასტოლური დისფუნქცია, მარცხენა წინაგულის მოცულობითი ინდექსი (LAVi), პულმონური ჰიპერტენზია.