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Association Between Right Ventricular Echocardiographic Parameters and HFA-PEFF Score in Heart Failure with Preserved Ejection Fraction

Korunmuş Ejeksiyon Fraksiyonlu Kalp Yetersizliğinde Sağ Ventrikül Ekokardiyografik Parametreleri ile HFA-PEFF Skoru Arasındaki İlişki

ORIGINAL ARTICLE
KLİNİK ÇALIŞMA

ABSTRACT

Objective: Heart failure with preserved ejection fraction (HFpEF) is a leading clinical syndrome, accounting for more than 50% of hospitalizations due to heart failure. The Heart Failure Association Pre-test assessment, Echocardiography and natriuretic Peptides, Functional testing and Final etiological diagnosis (HFA-PEFF) algorithm, used for the diagnosis of HFpEF, also has prognostic value. The primary purpose of this work was to explore the relationship between the HFA-PEFF score and right ventricular (RV) echocardiographic parameters.

Method: 127 patients diagnosed with HFpEF between January 2021 and November 2024, with adequate transthoracic echocardiography (TTE) images, were retrospectively evaluated. Patients were categorized into three prognostic risk groups based on their HFA-PEFF scores: low (0–2), intermediate (3–4) and high (5–6). RV function was assessed using Tricuspid annular plane systolic excursion (TAPSE), tricuspid annular S' velocity and RV free wall longitudinal strain (RVFW GLS). The relationship between the HFA-PEFF score and RV parameters was evaluated using One-way ANOVA and Spearman correlation analysis.

Results: Patients with high HFA-PEFF scores showed significant deterioration in TAPSE and RV GLS values. A moderate negative correlation was observed between HFA-PEFF score and RVFW GLS ($r = 0.50$, $P < 0.001$), while a mild negative correlation was found with TAPSE ($r = -0.35$, $P < 0.001$).

Conclusion: In HFpEF patients with poor prognosis as identified by the HFA-PEFF score, there was a marked deterioration in RV parameters, particularly RVFW 2D GLS and TAPSE. These findings suggest that incorporating RV parameters into HFpEF diagnostic and prognostic algorithms might provide additional clinical value.

Keywords: Heart failure with preserved ejection fraction, HFA-PEFF score, right ventricular function

ÖZET

Amaç: Korunmuş ejeksiyon fraksiyonlu kalp yetersizliği (KEFKY), kalp yetersizliği nedeniyle hastaneye yatışların yüzde 50'sinden fazlasını oluşturan önemli bir klinik sendromdur. KEFKY tanı algoritması olarak belirlenen HFA-PEFF, aynı zamanda prognostik öneme sahiptir. Çalışmanın birincil amacı, HFA-PEFF skorunun sağ ventrikül (RV) eko parametreleri ile ilişkisini araştırmaktır.

Yöntem: Ocak 2021 - Kasım 2024 tarihleri arasında KEFKY tanısı almış, uygun transtorasik ekokardiyografi (TTE) görüntülerine sahip 127 hasta retrospektif olarak değerlendirildi. Hastalar, HFA-PEFF skoruna göre düşük (0–2), orta (3–4) ve yüksek (5–6) kötü prognostik risk gruplarına ayrıldı. RV fonksiyonları; TAPSE, triküspit anulus S velositesi ve RV serbest duvar longitudinal strain (RV GLS) parametreleri ile ölçüldü. HFA-PEFF skoru ile RV parametreleri arasındaki korelasyon Spearman istatistiksel metodu ile değerlendirildi.

Bulgular: Yüksek HFA-PEFF skoruna sahip hastalarda TAPSE ve RV GLS değerlerinde anlamlı bozulma görüldü. HFA-PEFF skoru ile RV GLS arasında orta düzeyde korelasyon ($r = -0{,}50$, $P < 0{,}001$); TAPSE ile ise hafif korelasyon ($r = -0{,}35$, $P < 0{,}001$) bulundu.

Sonuç: HFA-PEFF ile belirlenen kötü prognoz riskine sahip KEFKY hastalarında, sağ ventrikül parametrelerinden özellikle sağ ventrikül 2D longitudinal strain ve TAPSE'de belirgin bozulma olduğu gösterilmiş olup bu bulgular, KEFKY tanı ve prognoz algoritmalarında sağ ventrikül parametrelerinin de eklenmesinin ek katkı sağlayabileceğini düşündürmektedir.

Anahtar Kelimeler: Korunmuş ejeksiyon fraksiyonlu kalp yetmezliği, HFA-PEFF skoru, sağ ventrikül fonksiyonu

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Heart failure with preserved ejection fraction (HFpEF) has increasingly gained attention as a complex clinical syndrome, largely due to advances in research and the refinement of diagnostic criteria. Its prevalence is steadily rising and it is predicted that in the near future, it will surpass heart failure with reduced ejection fraction (HFrEF) in prevalence.[1,2]

Numerous parameters are used to diagnose HFpEF. However, due to the presence of various specific diseases under this umbrella term and the resulting broad clinical spectrum, a clear and unified diagnostic algorithm is lacking. The European Society of Cardiology (ESC) heart failure guidelines recommend using echocardiographic parameters and blood biomarkers alongside clinical findings, for diagnosis.[3] In 2019, the ESC Heart Failure group developed a diagnostic algorithm for HFpEF.[4] The Heart Failure Association Pre-test assessment, Echocardiography and natriuretic Peptides, Functional testing and Final etiological diagnosis (HFA-PEFF) diagnostic algorithm includes transthoracic echocardiographic (TTE) parameters, originally part of the 2016 ESC diastolic dysfunction guideline, to assess left ventricular (LV) filling pressures, along with other markers recommended in the ESC HFpEF diagnostic algorithm. LV global longitudinal strain (LV GLS) is also included as a minor criteria.[4] Subsequent trials have demonstrated that the HFA-PEFF score is associated with prognosis inpatients with HFpEF.[5]

Contrary to common belief, HFpEF can affect the right ventricle (RV) even in its early stages and the presence of RV dysfunction in HFpEF is related to poor prognosis. However, apart from tricuspid regurgitation (TR) jet velocity, no other parameter reflecting RV dysfunction has been incorporated into diagnostic or prognostic algorithms, despite its significant clinical implications.[6,7] This study aimed to explore how right ventricular (RV) echocardiographic parameters relate to the HFA-PEFF algorithm, a tool with both diagnostic and prognostic relevance in HFpEF.

ABBREVIATIONS

AFI	Automated Function Imaging
ASE/EACVI	American Society of Echocardiography and the European Association of Cardiovascular Imaging
EF	Ejection fraction
ESC	European Society of Cardiology
GLS	Global longitudinal strain
HFA-PEFF	Heart Failure Association Pre-test assessment, Echocardiography and natriuretic Peptides, Functional testing and Final etiological diagnosis
HFpEF	Heart failure with preserved ejection fraction
HFrEF	Heart failure with reduced ejection fraction
LAVI	Left atrial volume index
LV	Left ventricle
LV GLS	LV global longitudinal strain
ROI	Region of interest
RV	Right ventricle
TAPSE	Tricuspid annular plane systolic excursion
TAVI	Transcatheter aortic valve implantation
TR	Tricuspid regurgitation
TTE	Transthoracic echocardiographic

Materials and Methods

Patient Inclusion and Exclusion Criteria

The study was conducted in accordance with the Declaration of Helsinki. This retrospective observational study was designed with the following inclusion and exclusion criteria:

Inclusion criteria: Patients diagnosed with HFpEF and admitted to our clinic between January 2021 and November 2024 were retrospectively evaluated. Patients over the age of eighteen with TTE images suitable for left and right ventricular measurements, as well as good quality for the assessment of global longitudinal strain (GLS), were included in the study.

Exclusion criteria: Reduced EF (EF < 50%), acute coronary syndromes, coronary artery bypass surgery, moderate-to-severe valvular disease, previous valve operations, pulmonary hypertension due to causes other than Group 2 (e.g., chronic lung disease, chronic thromboembolic pulmonary hypertension, pulmonary arterial hypertension, endocrine or connective tissue diseases), constrictive pericarditis, congenital heart diseases or renal failure (GFR < 60 ml/min), were excluded from the study. After obtaining ethical approval from the Ankara University Faculty of Medicine Human Research Ethics Committee (Approval Number: İ1-22-21, Date: 14.01.2021), echocardiographic images of 326 eligible patients were reviewed. Images were retrieved from the EchoPac archive system of the Ankara University Echocardiography Laboratory. A total of 127 patients with suitable images for left and right ventricular assessment were included to study.

General Evaluation and Measurements

Hospital records were used to obtain the clinical and demographic characteristics of the 127 patients. Laboratory data from within 24–48 hours prior to the TTE were recorded. Cardiovascular risk factors and medications used by the patients were also extracted from the archives.

HFA-PEFF Score

The HFA-PEFF score was published in detail by the ESC Heart Failure Association in 2019 as a consensus report.[4] In essence, the score is based on three main components as functional, morphological and biomarker. Major criteria in each component score two points, while minor criteria score one point. However, each component can contribute a maximum of two points. If at least one major criteria is positive in a component, two points are awarded; if no major criteria is present but at least one minor criteria is, one point is awarded. Multiple criteria in the same domain do not increase the score. Points are additive only across different domains: major and minor criteria in the same component are not cumulative. Criteria used in the scoring system are listed in Table 1.

Transthoracic Echocardiographic Examination

TTE was conducted using a General Electric (GE) Vivid E9 imaging system (GE Medical Systems, Chicago, USA). Echocardiographic measurements were taken according to the 2015 guidelines, provided by the American Society of Echocardiography and the European Association of Cardiovascular Imaging (ASE/EACVI).[8] Left ventricular diameters were measured using M-mode in parasternal long-axis views. Left ventricular ejection fraction (EF) was determined using the biplane modified Simpson method, based on measurements from apical four- and two-chamber views (EF % = Stroke Volume / LV end-diastolic volume × 100). The E/e' ratio was calculated by averaging septal and lateral e' values, in accordance with guideline recommendations.[8,9]

Table 1. HFA-PEFF diagnostic algorithm[4]

Functional	Morphological	Biomarker
Major criteria		
Septal e' < 7 cm/s or lateral e' < 10 cm/s or Average E/e' ≥ 15 or TR velocity > 2.8 m/s (PASP > 35 mmHg)	LAVi > 34 ml/m² or LVMI ≥ 149/122 g/m² (m/f) and RWT > 0.42	Sinus Rhythm: NT-proBNP > 220 pg/ml or BNP > 80 pg/ml Atrial Fibrillation: NT-proBNP > 660 pg/ml or BNP > 240 pg/ml
Minor criteria		
Average E/e' 9-14 or GLS < 16%	LAVi 29-34 ml/m² or LVMI ≥ 115/95 g/m² or RWT > 0.42 or LV wall thickness ≥ 12 mm	Sinus Rhythm: NT-proBNP 125-220 pg/ml or BNP 35-80 pg/ml Atrial Fibrillation: NT-proBNP 365-660 pg/ml or BNP 105-240 pg/ml

DD, Diastolic dysfunction; EF, Ejection fraction; HFpEF, Heart failure with preserved ejection fraction; HF, Heart failure; LAVi, Left atrial volume index; LV, Left ventricle; NT-proBNP, N terminal prohormone of brain natriuretic peptide; RV, Right ventricle; TR, Tricuspid regurgitation.

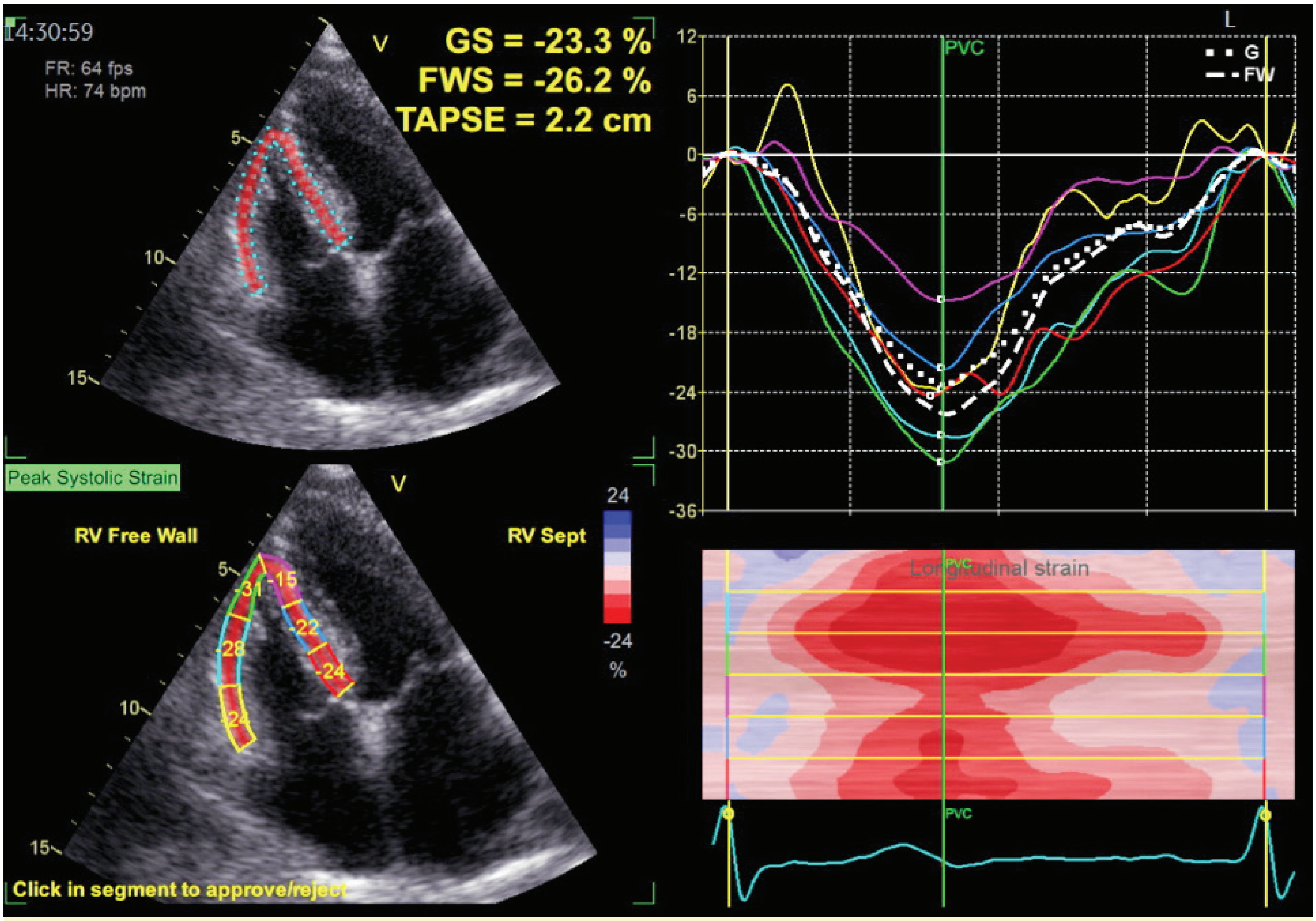

Figure 1. Example of RV 2D strain, TAPSE and tricuspid annular s velocity measurements.

GS, Global strain; FWS, Free wall strain.

Left atrial volume was assessed from apical four-chamber views and indexed to body surface area (LAVi in mL/m²).

2D Speckle Tracking Longitudinal Strain Measurement of the Left and Right Ventricles

RVFW GLS% and LV GLS% were evaluated using 2D speckle tracking based on ASE/EACVI consensus recommendations from 2015 and 2018.[10,11] Apical four-, three- and two-chamber views were used for LV analysis using Automated Function Imaging (AFI). Care was taken to avoid apical foreshortening. Images with well-defined endocardial borders were selected and the region of interest (ROI) was adjusted to cover the myocardium, without spilling into the endocardium or epicardium. For RV assessment, focused RV or apical four-chamber views without foreshortening

Table 2. Baseline characteristics divided by HFA-PEFF score

Characteristics	Total	Score 0-2 (n = 26)	Score 3-4 (n = 43)	Score 5-6 (n = 58)	P
Age, year	64 ± 10	62 ± 9	65 ± 9	65 ± 10	0.5
Female %	69 (54)	12 (46)	22 (51)	35 (60)	0.4
BMI	25 ± 2.6	25.3 ± 2.7	25.3 ± 2.6	24.5 ± 2.4	0.4
HT (%)	83 (65)	16 (62)	27 (63)	40 (69)	0.7
DM (%)	45 (35)	13 (50)	13 (30)	19 (33)	0.2
HL (%)	55 (43)	12 (46)	16 (37)	27 (47)	0.6
Smoking %	69 (54)	15 (58)	25 (58)	29 (50)	0.7
Atrial Fibrillation %	26 (21)	5 (19)	5 (12)	16 (28)	0.1
Medication					
ACE inhibitors/ ARB (%)	65 (51)	12 (46)	25 (58)	28 (48)	0.5
Beta blocker (%)	98 (77)	22 (85)	35 (81)	41 (71)	0.3
Statin (%)	73 (58)	20 (77)	21 (49)	32 (55)	0.07
Oral antidiabetic drug*	59 (47)	12 (46)	20 (47)	27 (47)	1
SGLT2 inhibitor	45 (35)	8 (31)	17 (40)	20 (35)	0.7
Insulin	55 (43)	12 (46)	18 (42)	25 (43)	0.9
Laboratory result					
FPG mg/dl	113.8 ± 50.3	122.5 ± 60.1	114.9 ± 58.9	109.1 ± 37.2	0.9
Hemoglobin g/dl	14.3 ± 1.7	14.3 ± 1.8	13.8 ± 1.8	14.5 ± 1.6	0.2
Creatine (mg/dl)	0.9 ± 0.2	0.9 ± 0.27	0.93 ± 0.21	0.92 ± 0.22	0.9
TC, mg/dl	177.4 ± 38.5	183.4 ± 35.9	179.3 ± 44.9	173.2 ± 34.5	0.5
TG, mg/dl	129 ± 41	125.2 ± 39.4	116.7 ± 40	139.8 ± 40.3	0.9
LDL-C, mg/dl	111 ± 38.2	122.3 ± 40.6	108.7 ± 35.1	107.5 ± 39	0.2
NT-proBNP pg/ml	231.9 ± 194.1	86.7 ± 41.3	169 ± 183.6	343.7 ± 179.8	0.000
Echocardiography					
LVEDD mm	49.6 ± 5.6	50.8 ± 5.6	48.1 ± 6	50.3 ± 5.2	0.08
LVESD mm	28.1 ± 4.3	30.2 ± 4.5	27.5 ± 4.7	27.6 ± 3.6	0.02
LVMI g/m^2	113.4 ± 26.9	111.1 ± 26.9	105.1 ± 27	120.5 ± 25.3	0.01
RWT	0.44 ± 0.9	0.4 ± 0.1	0.45 ± 0.1	0.45 ± 0.1	0.3
EF%	57.1 ± 3.6	57.6 ± 3.8	56.1 ± 3.4	57.5 ± 3.5	0.1
E/e	11.9 ± 3.7	10 ± 2.6	11.3 ± 3.1	13.3 ± 3.9	0.000
LV GLS %	17.1 ± 2.9	18.6 ± 2.5	18.1 ± 2.4	15.8 ± 2.9	0.000
LAVi ml/m2	33 ± 5.9	29.2 ± 3.9	32.9 ± 4.8	34.7 ± 6.7	0.000
TR jet velocity m/sn	2.6 ± 0.6	2.03 ± 0.5	2.7 ± 0.6	2.7 ± 0.6	0.000
TAPSE mm	16.9 ± 2.9	18.1 ± 3.5	17.9 ± 2.6	15.7 ± 2.3	0.04
Tricuspid annular S velocity cm/sn	11.8 ± 2.7	11.6 ± 3	12.4 ± 2.7	11.4 ± 2.6	0.2
RVFW GLS %	17.2 ± 2.6	19.2 ± 2.6	17.7 ± 2.2	15.8 ± 2	0.000

Values are reported as means±SD, as n (%)* Metformin-GLP-1 receptor agonist. ACE inhibitor/ARB, angiotensin converting enzyme inhibitor/Angiotensin receptor blocker; BMI, Body mass index; DM, Diabetes mellitus; EF, Ejection fraction; FPG, Fasting plasma glucose; HL, Hyperlipidemia; HT, Hypertension; LDL-C, Low-density cholesterol level; LVEDD, Left ventricular end-diastolic diameter, LVESD, Left ventricular end-systolic diameter; LVMI, Left ventricle mass index; LV GLS, Left ventricular global longitudinal strain; P, Probability; RVFW GLS, RV free wall longitudinal strain; RWT, Relative wall thickness; SGLT, Sodium glucose co-transporter 2; TAPSE, Tricuspid annular plane systolic excursion; TC, Total cholesterol; TG, Triglyceride.

and with clearly defined endocardial borders were used (Figure 1). All three segments (basal, mid and apical) of the RV free wall were required to have valid tracking. Images with poorly defined endocardium or missing segmental data were excluded. The ROI was adjusted specifically for RV myocardium. Both LV GLS% and RVFW GLS% values ≤ -20% were considered normal.

Statistical Analysis

In this study, categorical variables were reported as percentages, while numerical data is presented as mean ± standard deviation. Spearman's correlation analysis was conducted to explore the relationship between right ventricular (RV) echocardiographic parameters and the HFA-PEFF score. Patients were categorized

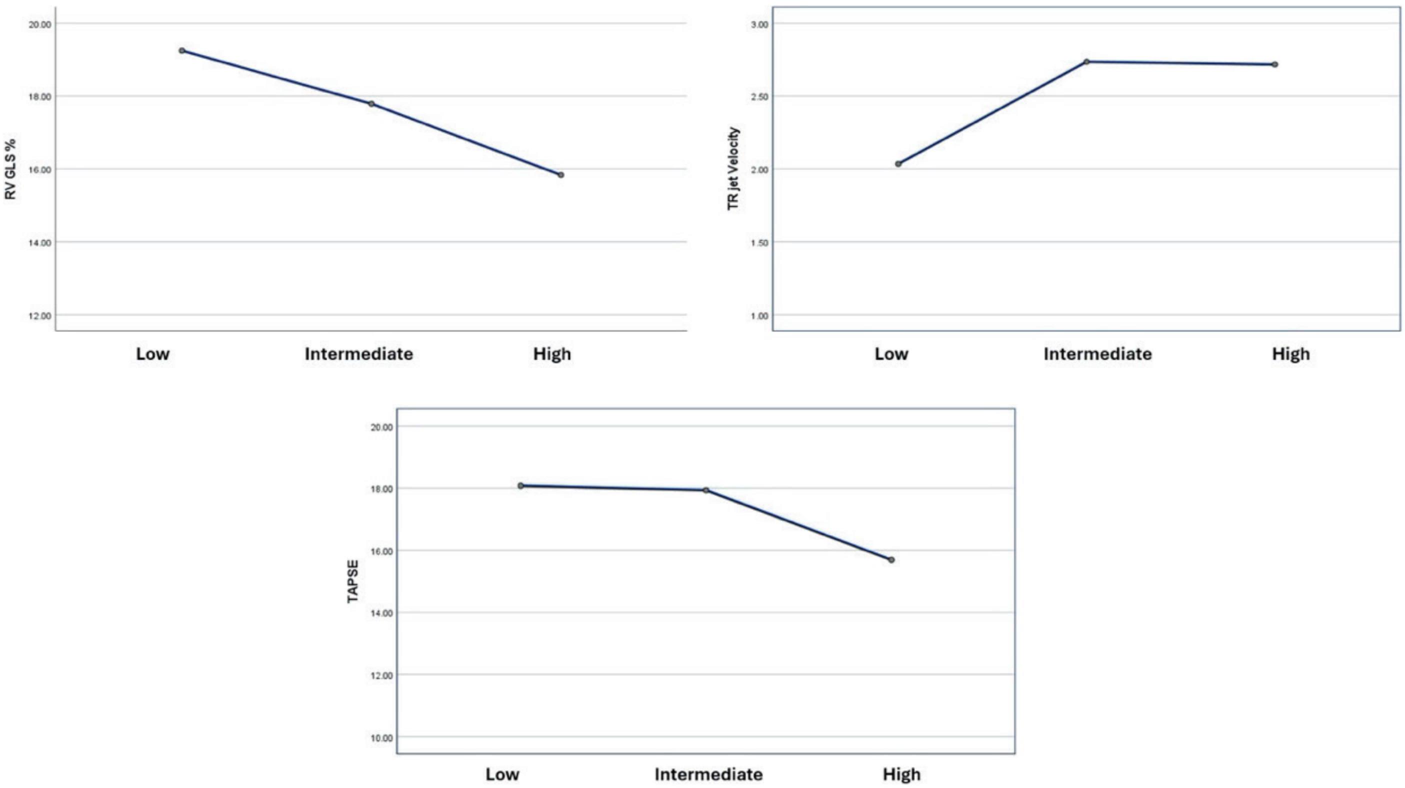

Figure 2. Post-hoc ANOVA analysis of repeated measures of RV GLS, TAPSE and TR jet velocity in three groups: Significant impairment in both TAPSE and RV 2D strain in the high-risk group compared to low- and intermediate-risk groups.

into three prognostic risk groups based on their HFA-PEFF scores: low (0–2), intermediate (3–4) and high (5–6). The differences in demographic, clinical, laboratory and echocardiographic parameters among the three groups were analysed using one-way ANOVA test. The Kruskal-Wallis test was employed for variables with non-normal distribution. Scheffé's post hoc test was used for further subgroup comparison. All statistical analyses were conducted using the IBM SPSS Statistics version 26 (SPSS Inc., Chicago, Illinois). A p-value of less than 0.05 was considered to indicated statistically statistical significance.

Results

The study included 127 patients who had been previously hospitalized at our clinic with a diagnosis of HFpEF and had suitable echocardiographic images. The mean age of the patients was 64 ± 10 years and 69 of them were female (54%). Table 2 summarizes the demographic characteristics, medication use, laboratory findings and echocardiographic parameters of the study population.

For the purpose of prognostic assessment, patients were stratified based on the HFA-PEFF score into three groups: Patients with a score of five or more were classified as high-risk, those with a score of three to four as intermediate-risk and those with a score equal or less than two as low-risk. There were 58 patients in the high-risk group, 43 in the intermediate-risk group and 26 in the low-risk group.

When demographic, laboratory and TTE parameters were compared among the three groups, parameters used in the HFA-PEFF scoring system showed significant differences, which was expected as they are part of the scoring algorithm. In addition to these parameters, the following also showed significant differences among the groups: [Left ventricular end-systolic diameter (LVESD) mm: (low: 30.2±4.5 vs. medium: 27.5±4.7 vs. high: 27.6±3.6; P = 0.02)], [Tricuspid annular plane systolic excursion (TAPSE) mm: (low: 18.1±3.5 vs. medium: 17.9±2.6 vs. high: 15.7±2.3; P = 0.04)], [RV GLS %: (low: -19.2±2.6 vs. medium: -17.7±2.2 vs. high: -15.8±2.0; P < 0.001)].

Post hoc analysis was conducted to determine which specific groups differed (Table 3). The RVFW GLS% was markedly reduced in the high-risk group relative to the low- and intermediate-risk groups (low vs. high: -19.2±2.6 vs. -15.8±2.0; P < 0.001), (medium vs. high: -17.7±2.2 vs. -15.8±2.0; P < 0.001). Similarly, TAPSE values were notably lower in the high-risk group (low vs. high: 18.1±3.5 vs. 15.7±2.3; P = 0.001), (medium vs. high: 17.9±2.6 vs. 15.7±2.3; P < 0.001) (Table 3, Figure 2).

Correlation Analysis

To explore the association between the HFA-PEFF score and right ventricular (RV) echocardiographic parameters, the Spearman correlation analysis was performed. A moderate inverse correlation was identified between the HFA-PEFF score and RV free wall global longitudinal strain (RVFW GLS) (r = –0.50; P < 0.001), as well as between the score and TR jet velocity (r = –0.41; P < 0.001). In addition, a weak negative correlation was detected between the score and TAPSE (r = –0.35; P < 0.001) (Table 4).

Table 3. Intergroup differences in clinical parameters based on HFA-PEFF score (post-hoc analysis)

Variables	HFA-PEFF (0–2) low	HFA-PEFF (3-4) intermediate	HFA-PEFF (5-6) high	P value low vs. intermediate	P value low vs. high	P value intermediate vs. high
NT-proBNP pg/ml	86.7 ± 41.3	169 ± 183.6	343.7 ± 179.8	0.13	0.000	0.000
LVESD mm	30.2 ± 4.5	27.5 ± 4.7	27.6 ± 3.6	0.03	0.03	1
E/e'	10 ± 2.6	11.3 ± 3.1	13.3 ± 3.9	0.3	0.000	0.03
LAVi ml/m^2	29.2 ± 3.9	32.9 ± 4.8	34.7 ± 6.7	0.03	0.000	0.3
LVMI g/m^2	111.1 ± 26.9	105.1 ± 27	120.5 ± 25.3	0.7	0.3	0.02
TR jet velocity m/sn	2.03 ± 0.5	2.7 ± 0.6	2.7 ± 0.6	0.000	0.000	0.000
TAPSE mm	18.1 ± 3.5	17.9 ± 2.6	15.7 ± 2.3	1	0.001	0.000
LV GLS %	18.6 ± 2.5	18.1 ± 2.4	15.8 ± 2.9	0.7	0.000	0.000
RVFW GLS %	19.2 ± 2.6	17.7 ± 2.2	15.8 ± 2	0.3	0.000	0.000

HFA-PEFF, Heart failure association pre-test assessment, echocardiography and natriuretic peptides, functional testing and final etiological diagnosis; NT-proBNP, N terminal prohormone of brain natriuretic peptide; LVESD, Left ventricular end-systolic diameter; LAVI, Left atrial volume index; LVMI, Left ventricle mass index; TR, Tricuspid regurgitation; TAPSE, Tricuspid annular plane systolic excursion; LV GLS, Left ventricular global longitudinal strain; RVFW GLS, RV free wall longitudinal strain.

Discussion

In our study, in addition to conventional echocardiographic measures used to assess right ventricular (RV) function, we also utilized RVFW GLS. When classifying cases into low, intermediate and high prognostic risk groups assigned by the HFA-PEFF score, we found that the group with higher scores "indicating poorer prognosis" had significantly impaired RVFW GLS and TAPSE values compared to the lower-risk groups. Furthermore, a fair correlation was observed between the HFA-PEFF score and RVFW GLS, suggesting that higher scores are associated with greater RV dysfunction as determined by both RVFW GLS and TAPSE.

It is widely recognized that HFpEF is a multifaceted clinical condition marked by hallmark features of heart failure, a left ventricular ejection fraction exceeding 50% and indicators of diastolic dysfunction—such as impaired myocardial relaxation, elevated filling pressures and increased ventricular stiffness.[3] Diastolic dysfunction is regarded as the central pathophysiological mechanism in HFpEF and invasive hemodynamic measurements remain the benchmark for assessing left ventricular filling pressures. However, due to their limited practicality and invasive nature have made TTE the most widely used to estimate LV filling pressure.[9] Parameters such as the E/e′ ratio, TR jet velocity and left atrial volume index (LAVi) are recommended by current guidelines for evaluating LV filling pressures.[9] The latest consensus also suggests that left atrial strain as a useful parameter particularly in patients with inconclusive findings.[12]

To reduce diagnostic ambiguity and develop a more inclusive diagnostic system, the ESC Heart Failure Association introduced the HFA-PEFF algorithm in 2019 4, which was later validated in multiple studies for its diagnostic utility.[13,14] Subsequent studies investigated its prognostic significance.[5,15] For example, Egashira et al.[16] demonstrated that a cut-off value of 4.5 on the HFA-PEFF score could identify HF-related adverse events beyond conventional prognostic indicators. Similarly, a meta-analysis confirmed the score's diagnostic and prognostic value, including its ability to predict overall mortality in HFpEF patients.[5] A 2022 study in ESC Heart Failure found that the HFA-PEFF score was found to be significantly associated with all-cause mortality and heart failure rehospitalizations in HFpEF patients, after transcatheter aortic valve implantation (TAVI), suggesting the score's potential role in risk stratification for TAVI patients.[17] In our study, according to studies outlined above, we used the HFA-PEFF score as a prognostic tool in HFpEF patients, categorizing the study population into three subgroups accordingly.

Table 4. Correlation between RV echo parameters and HAF-PEFF

Variables	r	P
TAPSE	-0.35	0.000
Tricuspid annulus S velocity	-0.08	0.3
TR peak velocity m/sec	-041	0.000
RV GLS%	-0.5	0.000

R, Correlation coefficient. TAPSE, Tricuspid annular plane systolic excursion; TR, Tricuspid regurgitation; RV GLS, Right ventricular global longitudinal strain.

The RV is significantly affected in HFpEF and RV dysfunction is known to be related to poorer prognosis in these patients.[7,18] Contrary to earlier assumptions, RV dysfunction can occur early in HFpEF due to increased pressures in the pulmonary vasculature.[19] Nagueh et al.[20] showed a strong correlation between estimated right atrial pressure via TTE and invasively measured pulmonary capillary wedge pressure (sensitivity 76%, specificity 86%). Similarly, Mele et al.[21] found a strong relationship between mean right atrial pressure and pulmonary capillary wedge pressure in patients with indeterminate left atrial pressure, as determined by the 2016 ASE/EACVI guidelines, attributing RV dysfunction to early pressure overload in the thin-walled RV.

In an animal study, the TAPSE/sPAB (systolic pulmonary artery pressure) ratio—a key indicator of RV-PA (pulmonary artery) coupling—was significantly reduced in HFpEF and showed strong correlation with invasively measured pulmonary vascular resistance.[22] This ratio provides crucial information about RV contractile function and the study revealed that even slight increases in mean pulmonary artery pressure in early HFpEF, can impair RV function through passive pressure fluctuations in the pulmonary vasculature.[23] Despite these important findings, RV functional parameters are still not incorporated into diagnostic and prognostic algorithms for HFpEF.

With the increasing use of strain imaging, 2D speckle tracking has become a routinely employed technique to assess RV systolic function. Evaluating RV systolic function via TTE is challenging and cardiac magnetic resonance imaging is widely regarded as the primary reference for RV EF.[24,25] However, the 2D strain technique is a sensitive, accessible and reproducible method that can detect subclinical dysfunction, even in the absence of RV dilation. RVFW GLS has been shown in numerous studies to have prognostic value.[26,27] We believe that in addition to traditional RV parameters, RVFW strain is a reliable marker capable of identifying early signs of dysfunction in patients without overt RV impairment. In our study, we therefore examined the relationship between RVFW strain and the HFA-PEFF score.

Ultimately, we found that RVFW GLS and TAPSE values were markedly impaired in the high-score (i.e., poor prognosis) group and RVFW GLS demonstrated intermediate correlation with the HFA-PEFF score. Based on these findings, we believe that incorporating TAPSE and RVFW GLS into diagnostic and prognostic algorithms used for HFpEF patients, could enhance the diagnostic accuracy and clinical utility of these tools.

Study Limitations

Several limitations must be acknowledged in this study. To begin with, the retrospective design and the modest sample size may affect the robustness of the findings. Additionally, due to its retrospective nature, TTE measurements were obtained either on the day of or the day prior to hospital discharge. Although these patients were assumed to be in a compensated (euvolemic) state, their volume status was not definitively known. It is well established that volume overload can influence diastolic parameters and right ventricular strain measurements. Despite these limitations, our study demonstrates that TAPSE and RVFW GLS values were significantly impaired in the poor prognosis group as defined by the HFA-PEFF algorithm, compared to other groups.

Conclusion

In our study, both RVFW GLS (%) and TAPSE values were notably diminished in patients with HFA-PEFF scores of five and six, indicating poor prognosis. Despite the limited number of participants, our results yield important contribution to a topic with scarce data in the literature. These results highlight the need for larger, prospective studies to further validate our conclusions.

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