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ORIGINAL RESEARCH

The Advances in Utilizing Right Ventricular Function as a Predictor of Peripartum Cardiomyopathy Recovery: A Single Centre Prospective Cohort Study

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Introduction: Peripartum cardiomyopathy (PPCM) is a pregnancy related cardiomyopathy with a high potential for recovery. One of the contemporary predictors studied in cardiomyopathy is right ventricular (RV) function during initial presentation.

Purpose: This study aimed to determine the role of RV systolic function based on the various RV function parameters by two-dimensional transthoracic echocardiography (2DE) to predict PPCM recovery within 6 months of follow-up and identify the most accurate parameter among them.

Patients and Methods: This was a prospective cohort study that include all patients registered in the "Long Term Registry on Patients with Peripartum Cardiomyopathy" at Dr. Hasan Sadikin General Hospital Indonesia during period of September 2014 until December 2022. Right ventricular systolic dysfunction was defined as abnormal value in one or more parameter(s), including tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), S', right ventricular free wall longitudinal strain (RVFWLS) and right ventricular global longitudinal strain (RVGLS). Left ventricular ejection fraction was measured on initial examination and after 6-month follow up to define recovery.

Results: A total of 95 patients were included in this study. There were 33 patients (34.7%) with reduced initial RV systolic function. Sixty-four patients (67.4%) recovered within 6 months follow up. The recovery rate of patients with initial RV systolic dysfunction is lower than patients with normal RV systolic function (51.5% vs 75.8%, p = 0.016). This study showed that initial RV systolic dysfunction can predict poor LV function recovery in PPCM patients (OR 0.340; 95% CI:0.120–0.959; p = 0.041). Among all RV function parameters, only FAC (OR 1.076; 95% CI:1.003–1.154; p = 0.040)) and RVGLS (OR 0.768; 95% CI: 0.595–0.991; p = 0.042) emerged as independent predictors of PPCM recovery.

Conclusion: Right ventricular function in terms of FAC and/or RVGLS at initial diagnosis can be used as a predictor for PPCM recovery at 6 months follow-up.

Keywords: FAC, PPCM, right ventricle, RVGLS

Introduction

Peripartum cardiomyopathy (PPCM) is a pregnancy-related cardiomyopathy develops either during prepartum or in the months following delivery. It manifests as heart failure with left ventricular ejection fraction (LVEF) below 45% without any other causes.[1] Compared to other forms of cardiomyopathy, this type typically has a higher rate of recovery and usually occurs within 6 months after diagnosis.[1] Our previous study showed significant mitral regurgitation (MR), left ventricular ejection fraction (LVEF) <30%, left ventricular end-diastolic diameter (LVEDD) ≥56 mm, and New York

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Heart Association (NYHA) functional class (FC) IV were all strong predictors for poor LV function recovery in PPCM patients.[2] Recently, right ventricular (RV) function has emerged as a subject of interest in several types of cardiac diseases, showing its potential as a prognostic predictor.[3–6]

Prior researches have shown RV systolic dysfunction in 35.3–54.6% of PPCM patients; however, none have focused on the various RV function parameters of two-dimensional transthoracic echocardiography (2DE).[7–10] The intricate geometry of the RV rendering it difficult to be precisely evaluated using 2DE, making Cardiac Magnetic Resonance (CMR) as the gold standard of RV function evaluation.[10,11] Nevertheless, CMR is not widely available and RV function is mostly evaluated by 2DE. In order to increase the accuracy of RV function evaluation, it is suggested to utilize multiple echocardiographic parameters.[12,13] In our early investigation, RV function was only evaluated using TAPSE parameter by 2DE, and we did not find any significance of RV function as a predictor for LV function recovery.[2] Meanwhile, other recent studies showed that RV systolic dysfunction is a predictor of major adverse cardiac events in PPCM patients; moreover, there are no studies focusing on RV function based on strain method in addition to conventional RV function parameters.[7–10] The current study aimed to determine the role of RV systolic function by 2DE (TAPSE, FAC, S’, RVFWLS and RVGLS) to predict PPCM recovery within 6 months of follow-up and identify the most accurate parameter among them.

Patient and Methods

Study Design

This was a single-centre, prospective cohort study. We included all PPCM patients aged ≥ 18 years old registered in Dr. Hasan Sadikin General Hospital in Bandung, Indonesia, in period of January 2014 until December 2022. Study approval was obtained from the Medical Research Ethics Committee of Dr. Hasan Sadikin General Hospital, Bandung, Indonesia according to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants. We excluded patients who (1) were lost to follow-up (2) had pulmonary disease (3) lacked accessible echocardiography data. This is an extension of our previous PPCM recovery predictor study, which focusing on more extensive RV function measurement by 2DE.[2]

Definition of Variables

Patients were diagnosed having PPCM if they met the following criteria: (1) presenting with congestive heart failure symptoms during the prepartum period or within a few months post-delivery, (2) LVEF < 45%, (3) absence of alternative causes of heart failure identified through clinical examination and several auxiliary tests prior to the last month of pregnancy.[1,2]

Baseline characteristics were collected upon initial diagnosis, including age, body mass index (BMI), comorbidities (chronic hypertension, hypertensive disorder of pregnancy, preeclampsia, and obesity (BMI > 25 kg/m2)), obstetric history (multiparity, twin pregnancies, and previous pregnancies resulting in fetal death), onset of PPCM, New York Heart Association (NYHA) functional classification (FC), heart rate, and blood pressure. Medication status assessed using an established heart failure optimal medical therapy scoring system, was recorded at the 6-month follow-up. Optimal medication status was defined by score ≥5.[14]

RV systolic dysfunction was defined by abnormalities in one or more RV function parameter(s), including TAPSE <17mm, FAC <35%, S’ <10 cm/second, RVFWLS > −20.2%, or RVGLS> −17.4%.[12,15]

Echocardiographic Examination

Examination of 2DE and 2D speckle tracking analysis were performed blindly to clinical data by a national certified cardiologist in echocardiography using General Electric Vivid E95, S6, S70N (GE Vingmed, Horten, Norway) echocardiogram. The echocardiography examination was performed at the time of initial diagnosis and 6 months of follow up.

The transthoracic echocardiographic examination comprising two-dimensional imaging, M-mode, and Doppler analysis, were recorded adhered to the American Society of Echocardiography (ASE) guidelines.[12,16,17] Parameters included left atrial diameter, LVEF, left ventricular end systolic diameter (LVESD), left ventricular end diastolic diameter

(LVEDD), mitral regurgitation and tricuspid regurgitation severity, as well as RV function parameters such as tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), S', right ventricular free wall longitudinal strain (RVFWLS) and right ventricular global longitudinal strain (RVGLS) were all obtained in accordance with the ASE guidelines.[12,16–18] We used high frame rate acquisitions (50–70 frames per second) with 2D dedicated LV (Automated Functional Imaging, AFI) software package in EchoPAC version 203 for RV strain analysis. The RV's endocardial border was manually traced and the speckle-tracking region of interest was adjusted to encompass the entire myocardium. The interventricular septum and the right ventricular free wall (RVFW) were automatically divided into six segments. The RVFWLS was computed as the average of the three segmental (basal, mid, apical) values of the RVFW, whereas the RVGLS was determined as the mean of the six segmental values.[18]

Study Outcomes

All patients underwent echocardiographic reassessment within six months after PPCM diagnosis. Patients with LVEF < 50% during this follow-up period were categorized into a non-LV recovery group.

Statistical Analysis

The Kolmogorov–Smirnov test was used to assess data normality. Continuous variables were presented as means ± standard deviations (SD) or median (min-max) for non-normally distributed data. Categorical data were summarized using frequencies and percentages. Associations between categorical variables and outcomes were evaluated using Chi-square or Fisher's exact tests. For numerical variables and outcomes, independent *t*-tests or Mann–Whitney *U*-tests were employed. In the multivariate analysis, four variables with the lowest p-values from the univariate analysis were included to identify independent factors related to outcomes. Significance was determined at $p < 0.05$. Receiver operating characteristic (ROC) analysis was used to assess the area under the curve (AUC) for predicting related outcomes, with the DeLong approach utilized to select the optimal cut-off point based on sensitivity and specificity.

Results

Baseline Characteristics

There was a total of 142 PPCM patients participated in our PPCM registry with 47 of them were excluded (9 deaths, 34 patients lost to follow-up and 4 with inaccessible echocardiography data). Subsequently, 95 patients were enrolled in this study, consist of 44 patients were diagnosed before delivery and in 51 patients during the postpartum period. The average age of participants was 30.0±5.8 years with mean LVEF of 33.8±6.1%. The flow of participant selection is illustrated in Figure 1. Patients were divided into two groups based on their RV systolic function, patients with RV systolic dysfunction (34.7%) and normal RV systolic function (65.3%) as presented in Table 1.

There were no significant differences in comorbidities, obstetric status, onset of peripartum cardiomyopathy (PPCM), body mass index (BMI), heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), or medication usage across the groups ($p > 0.05$). However, PPCM patients with RV systolic dysfunction were younger compared to those with normal RV systolic function (28.4±6.1 vs 30.9±5.5 years, $p = 0.04$). Optimal medical status was achieved in 77 (81.1%) patients and showed no significant difference across the groups ($p = 0.131$). The baseline characteristics of echocardiography examination showed that patients with RV systolic dysfunction had a lower initial LVEF compared to patients with normal RV systolic function (31.5±4.9 vs 35.1±6.3%, $p = 0.007$). (Table 2).

Right Ventricular Function Characteristic Differences in Recovered vs Non-Recovered PPCM Patients

In this study, LVEF recovery within 6 months was observed in 64 patients (67.4%), while 31 patients (32.6%) did not experience recovery. The LVEF showed improvement during the 6-month follow-up period (33.8±6.1% to 53.3±10.7%, $p < 0.001$), both within the RV systolic dysfunction group (31.5±4.9% to 52.0±12.7%, $p < 0.001$) and the normal RV systolic function group (35.1±6.3% to 54.3±9.6%, $p < 0.001$). However, the recovery rate among patients initially

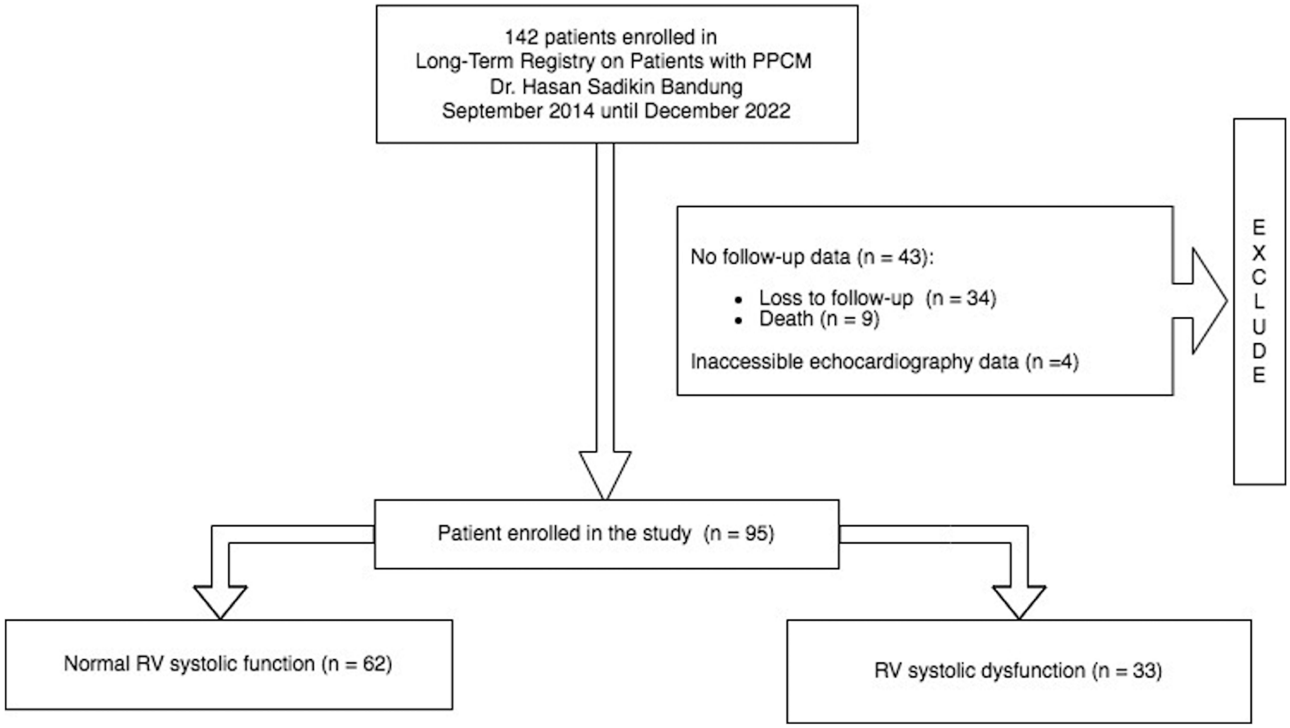

Figure 1 Study flowchart.

presenting with RV systolic dysfunction was lower compared to those with normal RV systolic function (51.5% vs 75.8%, p = 0.016).

In this study, TAPSE were obtained from all participants (95 patients) revealing that 19 patients (20%) had TAPSE <17%. The S' parameter was assessed in 36 subjects, among whom 8 patients (22.2%) had S'<10 cm/second. FAC data were collected from 41 subjects, indicating that 8 patients (19.5%) had FAC<35%; RVFWLS and RVFGLS assessments were conducted in 36 patients, with 17 patients (47.2%) had RVFWLS > −20.2%, and 19 patients (52.7%) had RVFGLS > −17.4%. Using the RV longitudinal strain parameter revealed a higher rate of RV systolic dysfunction (34.7%) among PPCM patient compared to 27.4% without strain parameter (p < 0.001).

The initial assessment of RV systolic function in all participants, based on TAPSE, S', and FAC parameters, indicated an average categorization as normal. However, further examination using RVFWLS (−19.9±6.5%) and RVGLS (−16.2 ±4.9%) revealed subclinical RV systolic dysfunction among the subjects (Table 3). Patients in the non-recovered group demonstrated lower initial RV systolic function compared to the recovered group, as indicated by FAC, RVFWLS, and RVGLS parameters. Over the 6-month follow-up period, improvements were observed in all these RV systolic function parameters.

Right Ventricular Function and PPCM Recovery

We found RV systolic dysfunction, initial LVEDD > 55 mm, and moderate-severe mitral regurgitation are independent variables as predictors of poor LV function recovery (Table 4). Patients with RV systolic dysfunction independently decreased the probability by 66% of PPCM recovery or 2.9 times higher risk of persistent LV dysfunction compared to patients with initially normal RV systolic function (OR = 0.340; 95% CI: 0.120–0.959; p = 0.041).

Among the five RV function parameters we evaluated, FAC (OR = 1.076; 95% CI: 1.003–1.154; p = 0.040) and RVGLS (OR = 0.768; 95% CI: 0.595–0.991; p = 0.042) emerged as independent variables predictive of PPCM recovery. Each 1% increase in FAC will increase the probability of recovery by 7.6% and each 1% improvement in RVGLS value will increase the probability of recovery by 30%. The combination of FAC and RVGLS parameters contributed to a Nagelkerke pseudo-R2 value of 0.514 in this model, suggesting that these factors together can explain 51.4% of LVEF

Table 1 Baseline Characteristics of Study Participants

Variables	Group			p
	All	RV Systolic Dysfunction	Normal RV Systolic Function	
	(n=95)	(n=33)	(n=62)	
Age (year)	30.0±5.8	28.4± 6.1	30.9±5.5	0.04*
Comorbidities, n (%)				
Chronic hypertension	51 (53.7)	17 (51.5)	34 (54.8)	0.757
Hypertensive disorder of pregnancy	16 (16.8)	3 (9.1)	13 (20.9)	0.163
Preeclampsia	57 (60.0)	16 (48.5)	41 (66.1)	0.095
Obesity	34 (35.8)	8 (24.2)	26 (41.9)	0.087
Obstetric status, n (%)				
Multiparity	66 (69.5)	17 (51.5)	49 (79.0)	0.006*
Twin pregnancy	9 (9.5)	4 (12.1)	5 (8.1)	0.715
History of pregnancy resulting in fetal death	31(32.7)	8 (24.2)	23 (37.1)	0.245
Prepartum PPCM onset, n (%)	44 (46.3)	13 (39.4)	31 (50.0)	0.324
Initial clinical status				
BMI (kg.m^{-2})	23.7 (14.6–50.9)	23.4(14.6–37.7)	24.2 (16.9–50.9)	0.081
NYHA functional class, n (%)				
II	10 (10.5)	3 (9.1)	7(11.3)	0.739
III	31 (32.6)	13 (39.4)	18 (29.0)	0.305
IV	54 (56.8)	17 (51.5)	37 (59.7)	0.444
Heart rate (beats per minute)	103.6±17.1	103.3±18.3	104.1±14.7	0.829
Systolic blood pressure (mmHg)	135 (90–197)	130 (90–160)	137.5 (90–197)	0.312
Diastolic blood pressure (mmHg)	90 (60–120)	90 (60–120)	90 (60–120)	0.599
Medication(s), n (%)				
Beta blocker	92 (96.8)	32 (96.9)	60 (97.8)	1.000
ACEi/ARB	86 (90.5)	29 (87.9)	57 (91.9)	0.715
Furosemide	61 (64.2)	19 (57.6)	42 (67.7)	0.325
MRA	26 (27.4)	11 (33.3)	15 (24.2)	0.341
Bromocriptine	5 (5.3)	2 (6.1)	3 (4.8)	1.000
Optimal medication status, n (%)	77 (81.1)	24(72.7)	53 (85.5)	0.131

Notes: *Significant p-value.
Abbreviations: ACEi, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; BMI, body mass index; DBP, diastolic blood pressure; MRA, mineralocorticoid receptor antagonist; NYHA,New York Heart Association; PPCM, peripartum cardiomyopathy.

recovery in our subjects. Our analysis showed the RVGLS cut-off level for LV recovery prediction was ≤ −16.2% with sensitivity of 80% and specificity of 70%, AUC 0.831, p = 0.002 (Figure 2).

Discussion

To the best of our knowledge, this is the first prospective cohort study in the Asian population that particularly investigates various echocardiography parameters related to RV function, including RVGLS and RVFWLS, over a 6-month follow-up period. The primary findings of this study are as follows: 1. The incidence of RV systolic dysfunction (34.7%) is quite similar with rates observed in Europe and North America. 2. Patients with RV systolic dysfunction demonstrated a lower PPCM recovery rate (51.5%) compared to those with normal RV systolic function (75.8%). 3. RV systolic dysfunction, in terms of abnormalities in FAC and/or RVGLS, can serve as predictors of poor LV function recovery.

Peripartum cardiomyopathy demonstrates a more favourable recovery rate compared to other forms of cardiomyopathies, with recovery probabilities ranging from 45% to 78% within six months post-diagnosis.[19–22] Our findings indicate that RV systolic dysfunction was an independent predictor of poor LV function recovery. Previous studies have showed that PPCM patients with RV systolic dysfunction present a more severe phenotype, characterized by biventricular

Table 2 Echocardiography Characteristic of Study Participants

Variables		Group		p
	All	RV Systolic Dysfunction	Normal RV Systolic Function	
	(n=95)	(n=33)	(n=62)	
Baseline LVEF (%)	33.8±6.1	31.5±4.9	35.1±6.3	0.007*
LVEF < 30%, n (%)	24 (27.0)	13 (41.9)	11 (18.9)	0.020*
LVEDD (mm)	55.3±5.3	55.2±5.3	55.3±5.4	0.891
LVEDD >55 mm, n (%)	52 (54.7)	16 (48.5)	36 (58.1)	0.372
LVESD (mm)	46.2±5.1	46.8±4.8	45.9±5.2	0.430
LVESD ≥ 42 mm, n (%)	78 (82.1)	28 (84.8)	50 (80.6)	0.611
LA diameter	37.9±6.1	36.8±7.6	38.6±5.1	0.257
LA dilatation (LA ≥ 40 mm), n (%)	35 (39.3)	13(41.9)	22(37.9)	0.713
Moderate - severe mitral regurgitation, n (%)	12 (13.8)	7 (21.9)	5 (9.1)	0.095
Moderate - severe tricuspid regurgitation, n (%)	3 (3.4)	1 (3.1)	2(3.7)	1.000

Notes:*Significant p-value.
Abbreviations: LA, left atrial; LVEDD, left ventricular end diastolic diameter; LVEF, left ventricular ejection fraction; LVESD, left ventricular end systolic diameter.

Table 3 Characteristic of Right Ventricle Function in PPCM Patients

Parameters	All	Recovered			Non-recovered			Baseline PPCM Recovered vs Non-recovered
	Baseline	Baseline	Follow-up	p	Baseline	Follow-up	p	p
TAPSE (mm) (n=88/95)	18.6±3.8	19.1±3.8	21.5±3.0	<0.001*	17.5±4.1	20.7±4.3	0.010*	0.058
S' (cm/second) (n=31/36)	10.6±2.2	11.0±1.6	11.7±1.6	0.165	10.6±2.6	11.7 ±2.0	0.174	0.443
FAC (%) (n=36/41)	50.9±15.4	57.9±12.5	63.9±9.1	0.006*	41.4±15.2	56.2±13.2	0.003*	0.001*
RVFWLS (%) (n=31/36)	−19.9±6.5	−21.7±6.1	−26.8±3.6	0.002*	−15.9±5.8	−23.6±6.0	0.014*	0.016*
RVFGLS (%) (n=31/36)	−16.2±4.9	−18.8±3.6	−23.0±2.8	<0.001*	−12.1±4.3	−19.0±4.6	<0.001*	0.001*

Notes: *Significant p-value.
Abbreviations: FAC, fractional area change; RVFWLS, right ventricular free wall longitudinal strain; RVGLS, right ventricular global longitudinal strain; TAPSE, tricuspid annular plane systolic excursion.

dysfunction, which can predict various adverse outcomes including persistent LV dysfunction, heart failure hospitalizations, mortality, and the need for cardiac assist device implantation.[7–10] While TAPSE is commonly utilized to assess RV function in clinical practice, our study, consistent with findings from Blauwet L et al and our previous study reveal that TAPSE is not a reliable predictor of PPCM recovery.[2,9,23] TAPSE assumes that the displacement of basal and adjacent segments of RV represents the entire RV function which in fact only contribute in 60–70% of RV function, giving a limitation of this parameter to calculate the interventricular septum contractility.[12,24] Similarly, S' is also not a reliable RV function parameter to predict RV recovery, as it relies on tissue Doppler, which is subject to variations in angle alignment and cardiac loading conditions during measurement, leading to potential alterations in its normal values, particularly in pregnancy.[12,24,25]

The FAC was found to have a significant role in PPCM recovery even after adjusting for LVEDD and moderate-severe mitral regurgitation parameters. We noted a significantly higher initial FAC in the recovered group compared to the non-recovered groups (57.9±12.5 vs 41.4±15.2, p = 0.001). This finding is consistent with studies conducted by Blauwet L et al and Kiran RG et al which also reported FAC as an independent predictor for PPCM recovery failure at 6 months and 1 year post-diagnosis.[9,26] FAC parameter has the capability to detect RV alterations, including those affecting the interventricular septum, unlike other parameters that primarily focus on the basal region of the RV.[12]

Table 4 Univariate and Multivariate Analysis of Predictors of PPCM Recovery

Parameters	B	SE	p	OR	CI 95%
Univariate					
RV systolic dysfunction	−1.081	0.457	0.018*	0.339	0.138–0.831
TAPSE	0.112	0.060	0.063	1.119	0.994–1.259
S'	0.179	1.791	0.290	1.196	0.859–1.666
FAC	0.094	0.033	0.005*	1.099	1.029–1.173
RVFWLS	−0.150	0.026	0.026*	0.861	0.755–0.982
RVGLS	−0.311	0.114	0.006*	0.733	0.586–0.917
Baseline LVEF < 30%	−0.783	0.504	0.121	0.457	0.170–1.228
Dilated LA (LA diameter ≥ 40 mm)	0.169	0.134	0.714	1.184	0.479–2.931
Baseline LVEDD >55 mm	−1.244	0.481	0.010*	0.288	0.112–0.740
Baseline LVESD ≥ 42 mm	−2.303	1.057	0.029*	0.100	0.013–0.793
NYHA Class IV	−0.473	0.451	0.295	0.623	0.257–1.510
Body mass index	−0.038	0.039	0.331	0.963	0.891–1.040
Diagnosis at prepartum	−0.867	0.459	0.059	0.420	0.171–1.032
Hypertensive disorder of pregnancy	1.401	0.791	0.077	4.060	0.861–19.140
Moderate-severe mitral regurgitation	−1.978	0.713	0.006*	0.138	0.034–0.560
Optimal medication status	0.630	0.474	0.239	1.878	0.657–5.367
Multivariate					
Model 1					
RV systolic dysfunction	−1.080	0.530	0.041*	0.340	0.120–0.959
LVESD ≥ 42 mm	−1.334	1.136	0.264	0.240	0.028–2.442
LVEDD >55 mm	−1.331	0.548	0.017*	0.270	0.092–0.789
Moderate-severe mitral regurgitation	−1.625	0.736	0.027*	0.197	0.047–0.834
Model 2					
LVEDD >55 mm	−1.562	1.256	0.214	0.210	0.018–2.460
Moderate-severe mitral regurgitation	0.839	2.513	0.738	2.314	0.017–319.007
FAC	0.073	0.036	0.040*	1.076	1.003–1.154
RVGLS	−0.264	0.130	0.042*	0.768	0.595–0.991

Notes: *Significant p-value. Model 1: Multivariate model adjusts RV systolic dysfunction for LVESD, LVEDD, mitral regurgitation. Model 2: Multivariate model adjusts FAC, RVGLS for LVEDD, mitral regurgitation.
Abbreviations: FAC, fractional area change; LA, left atrial; LVEDD, left ventricular end diastolic diameter; LVEF, left ventricular ejection fraction; LVESD, left ventricular end systolic diameter; NYHA, New York Heart Association; PPCM, peripartum cardiomyopathy; RV, right ventricle; RVFWLS, right ventricular free wall longitudinal strain; RVGLS, right ventricular global longitudinal strain; TAPSE, tricuspid annular plane systolic excursion.

Study using the strain method to measure RV systolic function in PPCM patients remains limited. Blauwet L et al study evaluating RV function using strain parameters showed a decrease in initial RVFWLS (−18.0 ± 6.4%) and RVGLS (−15.7 ± 5.7%) among PPCM patients.[9] In this study, we also identified reductions in RVFWLS (−19.9±6.5%) and RVGLS (−16.2±4.9%), and noted a significant difference in initial strain between the recovered and non-recovered groups. Moreover, RVGLS was found to play a significant role in recovery even after adjusting for LVEDD and moderate-severe mitral regurgitation parameters. In contrast to the study conducted by Blauwet L et al which reported that RVGLS and RVFWLS could not independently predict failure to recover and other cardiovascular events such as death and left ventricular assist device (LVAD) implantation, our findings revealed that RVGLS independently predicted PPCM recovery within 6 months of follow-up.[9] Differences in outcomes between Blauwet L et al and this current studies may account for this finding.

The mechanism of RV dysfunction is still not clearly defined. Potential mechanisms of RV systolic dysfunction include (1) the same cardiomyopathy mechanism that affects the LV also involves the RV, (2) ventricular interdependence

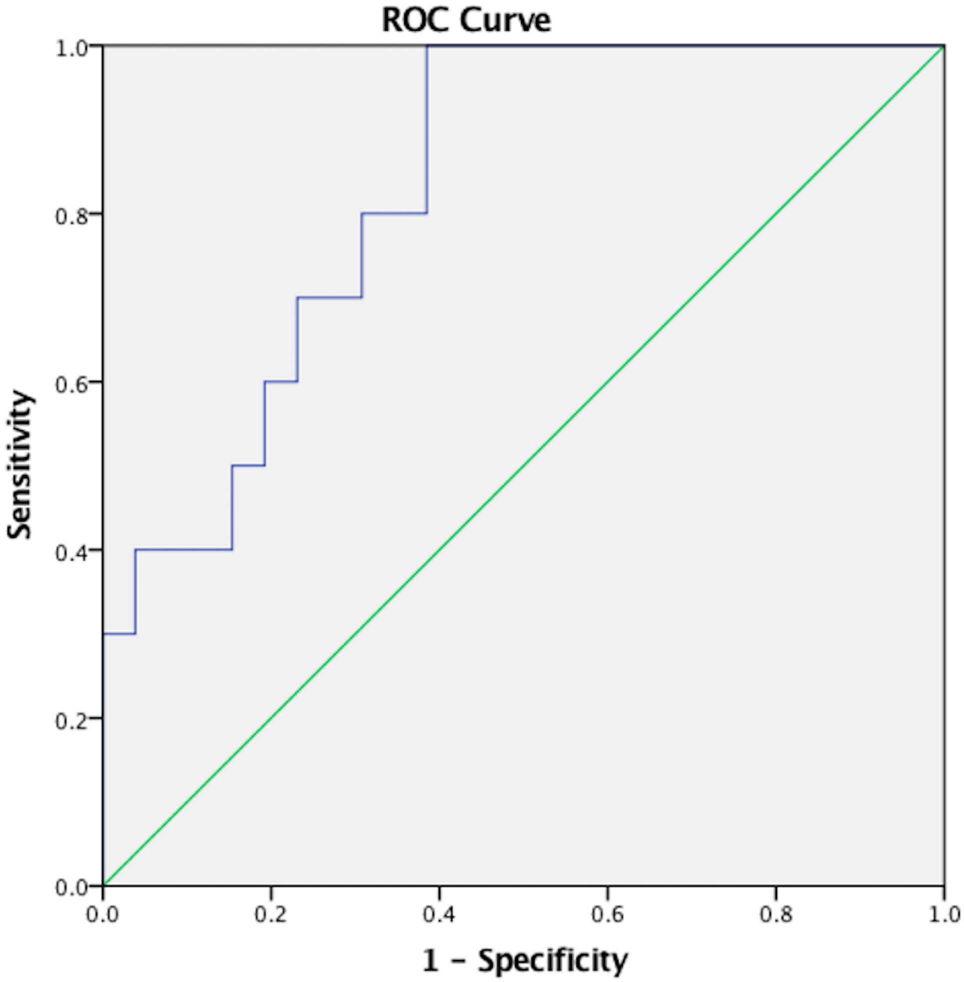

Figure 2 ROC Curve of RVGLS as a Predictor of PPCM Recovery.

in case of impaired interventricular septal contractility,(3) increased RV afterload due to post-capilary pulmonary hypertension and (4) genetic predisposition that makes individuals more prone to developing an RV dysfunction phenotype.[9,27] Our findings indicate FAC and RVGLS emerge as significant independent predictors of PPCM recovery. Even after adjusting for LVEDD and moderate-severe mitral regurgitation variables, these two parameters retain their strong influence on LV function recovery in PPCM. Both RV function parameters involve the interventricular septum in their examination, supporting the hypothesis that decreased of RV function in PPCM patients may be attributed to compromised interventricular septal contractility and ventricular interdependence resulting from septal dysfunction.[9,28] Cardiac magnetic resonance study in PPCM also showed the predominant LGE location at anteroseptal and basal to midventricular which causes local contractile dysfunction of the myocardium and ventricular dyssynchrony characterized by an abnormal septum movements that are discordant with the LV and RV movements.[10] Thus, RV systolic function which significantly could predict the probability of LV recovery in PPCM is considered to those more related to LV dysfunction as it affects the interventricular septum.

Limitation

This study has several limitations. This is a single-centre study, despite being conducted at a referral centre for PPCM patients in West Java, Indonesia, it still cannot explain the disparities in racial outcomes, which are likely to be multifactorial, including potential genetic, environmental, and possible health-care system differences. We recognized pulmonary artery pressure as a potential mechanism underlying right ventricular (RV) dysfunction. However, this observational study was not specifically designed to measure it accurately, particularly concerning the decongestion status at the time of examination. Additionally, right heart catheterization would be necessary to obtain precise results. Finally, we were unable to obtain cardiac magnetic resonance data, which is regarded as the gold standard for accurately assessing RV function.

Conclusion

Right ventricular function in terms of FAC and/or RVGLS at initial diagnosis can be used as a predictor for PPCM recovery at 6 months follow-up. FAC and RVGLS involve interventricular septum in their analysis thus highlighting the potential of interventricular interdependence as the cornerstone mechanism of RV function to predict PPCM recovery. Nonetheless, there is a need for research utilizing CMR (considered the gold standard) to assess RV function and pulmonary artery pressure measurement using right heart catheterization. Multicenter studies should also be conducted. Examination of RV function, particularly FAC and RVGLS, should be considered as a standard practice in routine echocardiography for PPCM patients.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Bauersachs J, König T, van der Meer P, et al. Pathophysiology, diagnosis and management of peripartum cardiomyopathy: a position statement from the Heart Failure Association of the European Society of Cardiology Study Group on peripartum cardiomyopathy. *Eur J Heart Fail*. 2019;21 (7):827–843. doi:10.1002/ejhf.1493
2. Prameswari HS, Iswandi CP, Hasan M, et al. Predicting poor left ventricular function recovery in Peripartum cardiomyopathy. *J Matern Fetal Neonatal Med*. 2023;36(2):2279018. doi:10.1080/14767058.2023.2279018
3. Gulati A, Ismail TF, Jabbour A, et al. The prevalence and prognostic significance of right ventricular systolic dysfunction in nonischemic dilated cardiomyopathy. *Circulation*. 2013;128(15):1623–1633. doi:10.1161/circulationaha.113.002518
4. D'Andrea A, Salerno G, Scarafile R, et al. Right ventricular myocardial function in patients with either idiopathic or ischemic dilated cardiomyopathy without clinical sign of right heart failure: effects of cardiac resynchronization therapy. *Pacing Clin Electrophysiol*. 2009;32(8):1017–1029. doi:10.1111/j.1540-8159.2009.02434.x
5. La Vecchia L, Paccanaro M, Bonanno C, Varotto L, Ometto R, Vincenzi M. Left ventricular versus biventricular dysfunction in idiopathic dilated cardiomyopathy. *Am J Cardiol*. 1999;83(1):120–2,a9. doi:10.1016/s0002-9149(98)00795-4
6. Mendes LA, Dec GW, Picard MH, Palacios IF, Newell J, Davidoff R. Right ventricular dysfunction: an independent predictor of adverse outcome in patients with myocarditis. *Am Heart J*. 1994;128(2):301–307. doi:10.1016/0002-8703(94)90483-9
7. Karaye KM. Right ventricular systolic function in peripartum and dilated cardiomyopathies. *Eur J Echocardiography*. 2011;12(5):372–374. doi:10.1093/ejechocard/jer024
8. Peters A, Caroline M, Zhao H, Baldwin MR, Forfia PR, Tsai EJ. Initial right ventricular dysfunction severity identifies severe peripartum cardiomyopathy phenotype with worse early and overall outcomes: a 24-year cohort study. *J Am Heart Assoc*. 2018;7(9):e008378. doi:10.1161/JAHA.117.008378
9. Blauwet LA, Delgado-Montero A, Ryo K, et al. Right ventricular function in peripartum cardiomyopathy at presentation is associated with subsequent left ventricular recovery and clinical outcomes. *Circ Heart Fail*. 2016;9(5). doi:10.1161/circheartfailure.115.002756
10. Haghikia A, Röntgen P, Vogel-Claussen J, et al. Prognostic implication of right ventricular involvement in peripartum cardiomyopathy: a cardiovascular magnetic resonance study. *ESC Heart Fail*. 2015;2(4):139–149. doi:10.1002/ehf2.12059
11. Ho SY, Nihoyannopoulos P. Anatomy, echocardiography, and normal right ventricular dimensions. *Heart*. 2006;92(Suppl 1):i2–i13. doi:10.1136/hrt.2005.077875
12. Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. *J Am Soc Echocardiography*. 2010;23(7):685–713;quiz786–8. doi:10.1016/j.echo.2010.05.010
13. Zaidi A, Knight DS, Augustine DX, et al. Echocardiographic assessment of the right heart in adults: a practical guideline from the British Society of Echocardiography. *Echo Res Pract*. 2020;7(1):G19–g41. doi:10.1530/erp-19-0051
14. DeFilippis EM, Fiuzat M. Putting the "Optimal" in Optimal Medical Therapy. *JACC Heart Fail*. 2021;9(1):39–41. doi:10.1016/j.jchf.2020.08.016
15. Badano LP, Muraru D, Parati G, Haugaa K, Voigt JU. How to do right ventricular strain. *Eur Heart J Cardiovasc Imaging*. 2020;21(8):825–827. doi:10.1093/ehjci/jeaa126
16. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *Eur Heart J Cardiovasc Imaging*. 2015;16 (3):233–271. doi:10.1093/ehjci/jev014
17. Zoghbi WA, Adams D, Bonow RO, et al. Recommendations for noninvasive evaluation of native valvular regurgitation: a report from the American Society of Echocardiography developed in collaboration with the society for cardiovascular magnetic resonance. *J Am Soc Echocardiography*. 2017;30(4):303–371. doi:10.1016/j.echo.2017.01.007

18. Badano LP, Kolias TJ, Muraru D, et al. Standardization of left atrial, right ventricular, and right atrial deformation imaging using two-dimensional speckle tracking echocardiography: a consensus document of the EACVI/ASE/Industry Task Force to standardize deformation imaging. *Eur Heart J Cardiovasc Imaging*. 2018;19(6):591–600. doi:10.1093/ehjci/jey042
19. Davis MB, Arany Z, McNamara DM, Goland S, Elkayam U. Peripartum cardiomyopathy: JACC state-of-the-art review. *J Am Coll Cardiol*. 2020;75(2):207–221. doi:10.1016/j.jacc.2019.11.014
20. McNamara DM, Elkayam U, Alharethi R, et al. Clinical outcomes for peripartum cardiomyopathy in North America: results of the IPAC study (investigations of pregnancy-associated cardiomyopathy). *J Am Coll Cardiol*. 2015;66(8):905–914. doi:10.1016/j.jacc.2015.06.1309
21. Goland S, Mouquet F. Chapter 3 - risk stratification in patients newly diagnosed with peripartum cardiomyopathy. In: Sliwa K, editor. *Peripartum Cardiomyopathy*. Academic Press; 2021:21–31.
22. Amos AM, Jaber WA, Russell SD. Improved outcomes in peripartum cardiomyopathy with contemporary. *American Heart Journal*. 2006;152(3):509–513. doi:10.1016/j.ahj.2006.02.008
23. Schneider M, Aschauer S, Mascherbauer J, et al. Echocardiographic assessment of right ventricular function: current clinical practice. *Int J Cardiovasc Imaging*. 2019;35(1):49–56. doi:10.1007/s10554-018-1428-8
24. Lancellotti P, Zamorano JL, Habib G, Badano LP. *The EACVI Textbook of Echocardiography*. Oxford University Press; 2016.
25. Melchiorre K, Sharma R, Khalil A, Thilaganathan B. Maternal cardiovascular function in normal pregnancy: evidence of maladaptation to chronic volume overload. *Hypertension*. 2016;67(4):754–762. doi:10.1161/hypertensionaha.115.06667
26. Ravi Kiran G, RajKumar C, Chandrasekhar P. Clinical and echocardiographic predictors of outcomes in patients with peripartum cardiomyopathy: a single centre, six month follow-up study. *Indian Heart J*. 2021;73(3):319–324. doi:10.1016/j.ihj.2021.01.009
27. Imran TF, Ataklte F, Khalid M, et al. Clinical predictors of right ventricular dysfunction and association with adverse outcomes in peripartum cardiomyopathy. *ESC Heart Fail*. 2024;11(1):422–432. doi:10.1002/ehf2.14583
28. Voelkel NF, Quaife RA, Leinwand LA, et al. Right ventricular function and failure: report of a National Heart, Lung, and Blood Institute working group on cellular and molecular mechanisms of right heart failure. *Circulation*. 2006;114(17):1883–1891. doi:10.1161/circulationaha.106.632208

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