Right ventricular systolic function in peripartum and dilated cardiomyopathies

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Aims

Right ventricular (RV) systolic function of peripartum cardiomyopathy (PPCM) has not previously been well described and compared with that of dilated cardiomyopathy (DCM). The aim of the present study was therefore to assess and compare RV systolic function between PPCM and idiopathic DCM, using tricuspid annular plane systolic excursion (TAPSE).

Methods and results

The study was cross sectional in design, carried out among adults referred for echocardiography to three laboratories in the City of Kano, Nigeria. Patients were recruited serially from October 2008 to May 2009. DCM and PPCM were defined according to the 2007 recommendations of the European Society of Cardiology working group on myocardial and pericardial diseases. Reduced TAPSE, signifying RV systolic dysfunction, was defined as value of ≤14 mm. A total of 90 patients were recruited over the 8 months period. Mean TAPSE was significantly less in PPCM (12.58 ± 4.27 mm) as compared with DCM patients (14.46 ± 3.21 mm) (P = 0.028; significant), while TAPSE ≤14 mm was found in 54.6% of PPCM patients and in 37.1% of DCM patients (P > 0.05; not significant).

Conclusion

The present study has found, perhaps for the first time, that RV systolic function in PPCM patients was worse than that of patients with idiopathic DCM.

Keywords

RV systolic function • TAPSE • PPCM • DCM

Introduction

Though the cardiac phenotype of peripartum cardiomyopathy (PPCM) resembles that of dilated cardiomyopathy (DCM), the two are considered to be distinctly different in several ways, such as in their clinical course.1 What has not been previously well described and compared is their right ventricular (RV) systolic function. In patients with DCM, RV dysfunction is an important adverse prognostic marker, associated with significantly worse functional class and outcome.2 Though the RV can now be imaged and studied in several ways, 2D-guided M-mode echocardiography is an attractive tool due to its simplicity and availability.

The aim of the present study was therefore to assess and compare RV systolic function between PPCM and idiopathic DCM, using tricuspid annular plane systolic excursion (TAPSE). TAPSE provides a simple and reproducible index for the assessment of global RV systolic function, which correlates excellently with RV ejection fraction.3

Methods

The study was carried out among adults referred for echocardiography to three laboratories in the city of Kano, North-Western Nigeria: Aminu Kano Teaching Hospital (AKTH), Murtala Muhammad Specialist Hospital (MMSSH) and a private centre.

The Research Ethics Committees of the study centres reviewed and approved the study protocol, which conformed to the ethical guidelines of the Declaration of Helsinki, on the principles for medical research involving human subjects.4 All recruited patients gave written informed consent to participate in the study.

The study was cross sectional in design. Patients were recruited serially from October 2008 to May 2009 from the three centres. Minimum sample size was estimated using a validated formula,5 applying a combined prevalence of PPCM and DCM in Kano of 19.5%6 and a sample error of 10%.

Transthoracic echocardiography was carried out by the author according to the recommendations of the American Society of Echocardiography.7 Patients were examined in the left lateral decubitus position. TAPSE was recorded from the apical four chamber view with the

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M-mode cursor positioned at the free wall angle of the tricuspid valve anulus, and the excursion was measured from end-systole to end-diastole. Reduced TAPSE, signifying RV systolic dysfunction, was defined as a value of ≤14 mm. This was found to be a strong predictor of death or emergency heart transplantation among patients with DCM.

DCM and PPCM were defined according to the 2007 recommendations of the European Society of Cardiology working group on myoccardial and pericardial diseases. This group defined DCM as the presence of left ventricular (LV) dilatation and LV systolic dysfunction in the absence of abnormal loading conditions (hypertension, valve disease) or coronary artery disease (CAD) sufficient to cause global systolic impairment. RV dilatation and dysfunction may be present but are not necessary for the diagnosis. They also defined PPCM as a form of DCM that presents with signs of cardiac failure during the last month of pregnancy or within the first 5 months after delivery.

Ischaemic heart disease (IHD) was excluded if all of the following were absent: history of angina or IHD, electrocardiographic changes suggestive of myoccardial infarction, and regional wall motion abnormalities on echocardiography. Patients with a history of taking excess alcohol or taking cardiotoxic drugs (such as anticancer and cocaine) were also excluded from the study.

Data were analysed with SPSS version 16.0. Means and standard deviations were computed and presented for quantitative variables. Student’s t-test and chi square ($\chi^2$) test were used for comparison between the groups as appropriate, with $P < 0.05$ regarded as significant. Multiple linear regression analysis was used to test for associations between TAPSE and a number of variables.

**Results**

A total of 90 patients were serially recruited over the 8 months period. The subjects were all being evaluated for the aetiology of heart failure (HF), and majority of them had moderate to severe symptoms. The results were presented in Table 1. Subjects with PPCM had significantly lower age, TAPSE, and body mass index (BMI) as compared with those with DCM, while other comparisons did not achieve statistical significance. In addition, BMI was found to be the only variable that had significant influence on TAPSE, in the multiple regression analysis (regression coefficient = 2.351; $P = 0.029$).

Table 2 shows a similar pattern of prescriptions for HF, between the two groups, at the time the subjects were referred for echocardiography.

**Discussion**

The present study has found, perhaps for the first time, that RV systolic function in PPCM patients was worse than that of patients with idiopathic DCM. Mean TAPSE was significantly less in PPCM as compared with DCM patients, while TAPSE ≤14 mm was found in the majority of PPCM patients, and in about one-third of DCM patients. These were seen in the context of similar sizes and volumes of cardiac chambers, systolic, and diastolic LV functions, and similar severity of HF symptoms and heart rate (HR), of the two conditions. It is important to point out that subjects in the two groups were referred for echocardiography for similar reasons (mainly to confirm the aetiology), within the acute phase of cardiac decompensation and presented with similar severity of symptoms. In addition, they were on similar drug prescriptions for HF. TAPSE is an index that is free of geometric assumptions, and a value of ≤14 mm is associated with an adverse prognosis in patients with idiopathic or ischaemic cardiomyopathy, as well as in patients with hypertensive heart disease.

It is our future research ambition to follow-up the PPCM and DCM patients so as to assess the prognostic significance of reduced TAPSE, and the possibility of its improvement with treatment, in these patients.

These results add further information to the differences between PPCM and DCM. Still, further studies are needed to corroborate the findings.

We recently described the clinical characteristics of these cardiomyopathies studied in the same centres. PPCM has been an important cause of morbidity and mortality in northern Nigeria for many decades, and we have identified it as the most

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**Table 1** Baseline and clinical characteristics

<table>
<thead>
<tr>
<th></th>
<th>DCM (n = 35)</th>
<th>PPCM (n = 55)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50.89 ± 19.33</td>
<td>24.53 ± 6.95</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Females</td>
<td>16 (45.7%)</td>
<td>55 (100%)</td>
<td>—</td>
</tr>
<tr>
<td>NYHA 3–4</td>
<td>29 (82.9%)</td>
<td>46 (83.6%)</td>
<td>0.923</td>
</tr>
<tr>
<td>TAPSE (mm)</td>
<td>14.46 ± 3.21</td>
<td>12.58 ± 4.27</td>
<td>0.028*</td>
</tr>
<tr>
<td>TAPSE ≤14 mm</td>
<td>13 (37.1%)</td>
<td>30 (54.6%)</td>
<td>0.107</td>
</tr>
<tr>
<td>RVOTd (mm)</td>
<td>33.52 ± 6.69</td>
<td>32.50 ± 5.17</td>
<td>0.419</td>
</tr>
<tr>
<td>HR (b/min)</td>
<td>106.4 ± 22.5</td>
<td>104.9 ± 15.3</td>
<td>0.737</td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>23.76 ± 4.65</td>
<td>20.24 ± 2.72</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>LA (mm)</td>
<td>44.97 ± 7.35</td>
<td>42.02 ± 7.52</td>
<td>0.070</td>
</tr>
<tr>
<td>LVEDD (mm)</td>
<td>66.51 ± 8.19</td>
<td>66.71 ± 7.80</td>
<td>0.910</td>
</tr>
<tr>
<td>LVEDV (ml)</td>
<td>252.03 ± 78.80</td>
<td>250.55 ± 69.80</td>
<td>0.927</td>
</tr>
<tr>
<td>LVSV (ml)</td>
<td>72.86 ± 36.09</td>
<td>68.35 ± 24.66</td>
<td>0.483</td>
</tr>
<tr>
<td>LVESV (%)</td>
<td>28.91 ± 8.81</td>
<td>27.27 ± 9.46</td>
<td>0.412</td>
</tr>
<tr>
<td>EA ratio</td>
<td>2.63 ± 2.27</td>
<td>2.57 ± 2.52</td>
<td>0.932</td>
</tr>
<tr>
<td>PV AT (ms)</td>
<td>74.90 ± 19.03</td>
<td>85.19 ± 25.58</td>
<td>0.285</td>
</tr>
</tbody>
</table>

NYHA, New York Heart Association classification; TAPSE, tricuspid annular plane systolic excursion; RVOTd, right ventricular outflow tract dimension at end-diastole; HR, heart rate; BMI, body mass index; LA, left atrium; LVEDD and LVEDV, LV end-diastolic and end-systolic dimensions, respectively; LV EF, left ventricular ejection fraction; EA, ratio of early to late mitral valve filling velocities; EDV, end-diastolic volume; SV, stroke volume; PV AT, pulmonary valve acceleration time. *P-value statistically significant. All values are expressed as means ± standard deviations, or as numbers with percentages in parentheses.

**Table 2** Prescribed drugs for heart failure among subjects with PPCM and DCM

<table>
<thead>
<tr>
<th>Drugs</th>
<th>DCM (n = 35)</th>
<th>PPCM (n = 55)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frusemide</td>
<td>33 (94.3)</td>
<td>51 (92.7)</td>
<td>0.773</td>
</tr>
<tr>
<td>Digoxin</td>
<td>29 (87.9)</td>
<td>44 (80.0)</td>
<td>0.736</td>
</tr>
<tr>
<td>Spironolactone</td>
<td>20 (57.1)</td>
<td>31 (56.4)</td>
<td>0.942</td>
</tr>
<tr>
<td>ACE-I</td>
<td>7 (20.0)</td>
<td>9 (16.4)</td>
<td>0.660</td>
</tr>
<tr>
<td>B-blockers</td>
<td>4 (11.4)</td>
<td>6 (10.9)</td>
<td>0.746</td>
</tr>
</tbody>
</table>

ACE-I, angiotensin-converting enzyme inhibitors. All values are expressed as numbers with percentages in parentheses.
common type of cardiomyopathy in Kano, Nigeria.\textsuperscript{12} Its aetiology is still unclear though many factors have been implicated, including certain cultural practices during the puerperal period in northern Nigeria, African ancestry, poverty, micronutrient deficiency, inflammatory and autoimmune diseases, hormonal imbalances, etc.\textsuperscript{6,13,14} Though PPCM is highly prevalent, it is however common knowledge that the cultural practices identified decades ago to be important in the aetiology of peripartum cardiac failure in Zaria, a city about 120 km from Kano, are no longer fashionable. They are practised by the Hausa and Fulani ethnic groups across northern Nigeria with less frequency, for shorter duration of time within the puerperal period, or even abandoned (as in the case of lying on heated mud beds) by most women in the present northern Nigeria. These cultural practices include frequent hot baths by breastfeeding mothers during the puerperal period, together with regular ingestion of a thick drink made from millet and rich in dry lake salt, ‘Kunun Kanwa’, and lying on heated mud beds.\textsuperscript{13}

The study has some limitations, including the use of TAPSE to assess RV systolic function. Studies have shown the superiority of magnetic resonance imaging over other techniques in studying the RV.\textsuperscript{15} However, echocardiography still has acceptable sensitivity, is widely available and affordable, and therefore has an important role in studying the RV despite its limitations. In addition, TAPSE is easy to obtain, is reproducible, and is without significant inter-observer variability.\textsuperscript{3} Another limitation is the non-availability of coronary angiography in Kano state (Nigeria) to exclude CAD. This is because rarely, CAD/IHD can present without angina, and with a normal ECG and global LV hypokinesis.\textsuperscript{16} Given the rarity of this possibility and of CAD/IHD in Nigeria (and Sub-Saharan Africa), it is unlikely that such misdiagnosis (if any) could alter our results significantly. Though desirable, we could not assess several echocardiographic variables, such as pulmonary artery systolic pressure and pulse tissue Doppler indices, because the echocardiography machines at two of the three study centres did not have continuous wave and tissue Doppler facilities.

**Acknowledgements**

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**Conflict of interest:** none declared.

**References**