Etiology and predictors of heart failure in pregnancy. Newer Insights from the M-PAC registry

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Background: Women with heart disease undergoing pregnancy is on the increase, along with an increasing cardiac contribution to maternal mortality.

Aim: To identify the proposition of pregnant women with heart disease, who develop heart failure as a complication and to identify the predictors of heart failure in pregnancy

Methods: The Madras medical college Pregnancy And Cardiac (M-PAC) registry (1) is a single-centre prospective observational registry conducted at a tertiary care public hospital in Tamil Nadu, India from July 2016 to December 2019. Patient with new or worsening heart failure during pregnancy and up to 1 week post-delivery were included in the present analysis. When heart failure was the presenting symptom, it was considered as the primary event and when patient presented with failure symptoms secondary to another inciting event, heart failure was considered as secondary event. This cohort of patient were evaluated for the aetiology, predictors and outcome of heart failure and were placed on extended follow up. The accuracy of mWHO and CARPREG I score to predict heart failure were assessed.

Results: 1005 women with 1029 pregnancies were enrolled. Heart failure was observed in 127 (%) pregnancies, in 103 as primary event and in 24 as a secondary event. The common aetiologies of heart failure include rheumatic valvar heart diseases (n=45), peripartum cardiomyopathy (n=45) and congenital heart diseases (n=18). The univariable predictors of heart failure include, NYHA class at first visit, mWHO class of disease, first diagnosis of heart disease, during current pregnancy, pulmonary hypertension, left ventricular ejection fraction ≤ 45%, significant mitral stenosis, mechanical prosthetic heart valve and history of prior cardiac events. However, when peripartum cardiomyopathy was excluded from the analysis, current pregnancy diagnosis was no longer a predictor. Multivariable predictors of heart failure are shown in Figure-1. CARPREG-1 score was marginally more effective than modified World Health Organisation (mWHO) score (C-statistic of 0.820 vs 0.802) in predicting heart failure (Figure-2). Maternal death was 15.7% (20/127).

Caesarean delivery was more common in patients with heart failure (53/119; 44.5%; vs 318/838; 38%) Patients with heart failure had significantly higher proportion of composite adverse fetal outcome (46.5% vs 31.9%, P<0.001), preterm birth (9.2% vs 4.5%, P=0.029) and low birth weight (41.2% vs 26%, P<0.001)

Conclusion: Heart failure is the commonest complication of pregnant women with heart disease. Mortality is very high in patients presenting with heart failure. Modified WHO classification and CARPREG 1 score have moderate accuracy to predict heart failure in pregnancy.

**Figure-1: Predictors of heart failure- Multivariable analysis**

<table>
<thead>
<tr>
<th>MPAC predictors of heart failure</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>mWHO Class &gt; II</td>
<td>5.765</td>
<td>1.565 - 21.234</td>
<td>0.008</td>
</tr>
<tr>
<td>NYHA class &gt; II</td>
<td>138.535</td>
<td>43.679 - 439.387</td>
<td>0.006</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>2.353</td>
<td>1.138 - 4.471</td>
<td>0.021</td>
</tr>
<tr>
<td>Prosthetic heart valves</td>
<td>3.249</td>
<td>1.119 - 9.433</td>
<td>0.030</td>
</tr>
<tr>
<td>Left ventricular ejection fraction &lt; 45%</td>
<td>6.989</td>
<td>1.706 - 28.633</td>
<td>0.007</td>
</tr>
<tr>
<td>Mitral stenosis (valve area &lt; 1.5 cm²)</td>
<td>1.993</td>
<td>0.940 - 4.228</td>
<td>0.072</td>
</tr>
</tbody>
</table>

Fig-1: Predictors of Heart Failure
Figure-2: Predicting Heart failure in pregnancy by mWHO class & CARPREG I score

- ROC Curve

- c-Statistic values
  - CARPREG 1 : 0.820 [95%CI:0.779-0.862]
  - mWHO class : 0.802 [95%CI:0.772-0.833]

Fig-2: Prediction by CARPREG-1 and mWHO