Glucose tolerance in rural women with pre-eclampsia

M Mammen, G A B Buga, J E Iputo

Objective. To determine the relationship between pre-eclampsia and glucose intolerance among rural women from the Transkei region of South Africa.

Methods. Women with confirmed pre-eclampsia underwent a 75 g, 3-hour oral glucose tolerance test. A control group of normotensive pregnant women were subjected to a similar glucose tolerance test. Pre-eclampsia was defined as blood pressure (BP) of at least 140/90 mmHg occurring for the first time after mid-pregnancy, in association with proteinuria. The control group comprised women with singleton pregnancy and normal BP, with age, parity and gestational age comparable to those of the pre-eclampsia group.

Results. There were 117 subjects in the pre-eclampsia group and 94 in the normotensive pregnancy group. Mean fasting plasma glucose levels in the pre-eclampsia group (3.88 ± 0.05 mmol/l) were similar to levels in the normotensive group (3.97 ± 0.05 mmol/l, p = 0.214). Peak post-load plasma glucose levels in the pre-eclampsia group (5.96 ± 0.12 mmol/l) were similar to levels in the normotensive group (5.71 ± 0.13 mmol/l, p = 0.180), and post-load incremental glucose area under the curve in the pre-eclampsia group (4.16 ± 0.21) was similar to that in the normotensive group (3.95 ± 0.21, p = 0.495).

Conclusion. Rural women with pre-eclampsia from the Transkei region of South Africa have normal glucose tolerance.


Pre-eclampsia is defined as the development of hypertension with proteinuria in the second half of pregnancy in a previously normotensive woman. It is a disorder peculiar to human pregnancy and is one of the leading causes of maternal and perinatal death in the Transkei region of South Africa. Although extensively investigated, the pathogenesis of pre-eclampsia is still unclear. Studies from Pakistan, China, Scandinavia and the USA have suggested that pre-eclampsia behaves like essential hypertension, where there is glucose intolerance associated with insulin resistance. But other studies in the Western world and in Africa have shown normal glucose tolerance and absence of insulin resistance in pre-eclampsia. This study investigated the glucose tolerance status of pre-eclamptic women in rural Transkei, an area with a high prevalence of the condition.

Methods and materials

Subjects

Subjects were selected from pregnant women with mild to moderate pre-eclampsia admitted to the antenatal ward of Umtata General Hospital, the regional hospital for the Transkei region. Selection was on the basis of blood pressure (BP) ≥ 140/90 mmHg and proteinuria ≥ 1+ (using the urinary dipstick method) at 25 or more weeks’ gestation. The following

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subject seated upright. A mercury sphygmomanometer was used and the Korotkoff phase IV was taken as the diastolic point. BP measurements were performed before the oral glucose tolerance test (OGTT), 24 hours after delivery, and 6 weeks after delivery.

**Proteinuria**

Random urine samples were analysed for protein using both the urinary dipstick method and laboratory analysis. A dipstick reading of 1+ or more was indicative of proteinuria. A laboratory reading of urinary protein 100 mg/l or more was confirmatory of proteinuria.

**Oral glucose tolerance test**

All the glucose tolerance tests were performed in the antenatal wards of Umtata General Hospital. All subjects received a standard diet (8694 kJ/day) the day before the glucose tolerance test. The test was performed at 07h00 after an overnight (10-hour) fast. The subject remained seated throughout the test.

Each subject was given glucose solution (75 g glucose/300 ml water) orally. Venous blood samples were obtained at the following times: 0, 60, 120 and 180 minutes after the ingestion of glucose. Blood samples were drawn into vacuutainer tubes containing potassium oxalate and immediately centrifuged at 3,000 rpm for 5 minutes. The plasma was transported to the laboratory on dry ice and was stored at -70°C until the time of batch analysis. The plasma glucose was measured using the colorimetric, hexokinase glucose-6-phosphate dehydrogenase method using the Beckman glucose reagent kit (Beckman Synchron CX system, Brea, Calif., USA).

Glucose tolerance was evaluated by means of the fasting plasma glucose level, the peak plasma glucose level following ingestion of a 75 g glucose load, and the incremental glucose area under the curve (GAUC), calculated using the trapezoid formula, following ingestion of a 75 g glucose load.

**Statistical analysis**

Data were expressed as means ± standard deviation (SD). All the anthropometric, biochemical and BP measurements had normal distribution patterns. Intergroup comparison was done using the Mann-Whitney test. All data were processed and analysed using a commercially available statistics software package (STATISTICA).

**Results**

**Anthropometric measurements**

One hundred and seventeen subjects with pre-eclampsia and 94 subjects with normal pregnancy were recruited into the study. Table I shows the characteristics of the pre-eclampsia and the normal pregnancy study groups. The study groups were similar in age, parity and gestational age. The pre-eclampsia group had a significantly higher body weight and body mass index (BMI).

There were subtle differences in the lipid profile between the pre-eclampsia and normal pregnancy groups. The fasting serum total free fatty acid concentration in the pre-eclampsia group (0.44 ± 0.02 mmol/l) was similar to that in the normal pregnancy group (0.40 ± 0.03 mmol/l, p = 0.7). The fasting serum triglyceride concentration in the pre-eclampsia group (2.32 ± 0.12 mmol/l) was significantly higher than that in the normal pregnancy group (1.86 ± 0.07 mmol/l, p = 0.042). The fasting serum high-density lipoprotein concentration in the pre-eclampsia group (0.92 ± 0.03 mmol/l) was significantly lower than that in the normal pregnancy group (1.10 ± 0.04 mmol/l, p = 0.037), and the fasting serum low-density lipoprotein concentration in the pre-eclampsia group (3.03 ± 0.13 mmol/l)
SAMJ was similar to that in the normal pregnancy group (3.06 ± 0.15 mmol/l, \( p = 0.85 \)).

The results of the OGTT are given in Table II and in Fig. 1. The fasting plasma glucose level was similar in both study groups. There was no significant correlation between fasting plasma glucose level and age, parity, or BMI in both study groups.

The OGTT was normal in both study groups. There was no significant difference in the plasma glucose levels at 60, 90 and 180 minutes of the OGTT. The post-loading peak plasma glucose level was similar in both groups. In the pre-eclampsia group, but not in the normal pregnancy group, there was a significant correlation between age and peak plasma glucose level (\( r = 0.33, p < 0.01 \)). This correlation was independent of the BMI.

The incremental GAUC, depicted in Fig. 1, was similar in the two groups. In both groups, the GAUC was significantly higher in the fourth decade than in the second decade. In the normal pregnancy group there was a significant positive correlation between GAUC and BMI (\( r = 0.21, p < 0.05 \)). This relationship was not evident in the pre-eclampsia group.

### Discussion

The present study demonstrated that glucose tolerance was normal in our pre-eclampsia subjects despite the presence of dyslipidaemia. Fasting blood sugar level, the post-load peak glucose level, and the post-load incremental GAUC are markers of insulin sensitivity. All these parameters were shown to be normal in this study, reflecting the relative normalcy of insulin sensitivity in our subjects. Insulin resistance is therefore unlikely to be the main explanation for the relative dyslipidaemia observed in our pre-eclampsia subjects.

The normal glucose tolerance observed in this study is in conformity with findings of other recent studies\(^{14-17}\) which have shown that pre-eclampsia per se is not associated with abnormal glucose tolerance. Abnormal glucose tolerance is observed in the gestational hypertension variant of pregnancy-induced hypertension. In the past, there was lack of uniformity in classifying hypertensive disorders of pregnancy. Often pre-eclampsia and gestational hypertension have been lumped together as different manifestations of the same disease, and studies carried out on the basis of such classification indicated the presence of glucose intolerance in pre-eclampsia.\(^{14,15}\) But studies that clearly define and separate pre-eclampsia from gestational hypertension demonstrate the difference in glucose tolerance between these variants of pregnancy-induced hypertension, probably pointing to distinctive pathophysiology.\(^{16}\)

### Conclusion

There is normal glucose tolerance in pre-eclamptic rural black women from the Transkei region of South Africa.

Funding for the study was received from the Medical Research Council of South Africa.

### References


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**Table II. Anthropometric and biochemical variables by age and study group (mean (SD))**

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>N</th>
<th>BMI (kg/m²)</th>
<th>Fasting glucose (mmol/l)</th>
<th>Peak glucose (mmol/l)</th>
<th>GAUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>27</td>
<td>28.7</td>
<td>3.7</td>
<td>5.66</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.4)</td>
<td>(0.4)</td>
<td>(1.43)</td>
<td>(2.2)</td>
</tr>
<tr>
<td>20 - 29</td>
<td>46</td>
<td>29.8</td>
<td>4.1</td>
<td>6.15</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.4)</td>
<td>(0.7)</td>
<td>(1.32)</td>
<td>(1.8)</td>
</tr>
<tr>
<td>30 - 39</td>
<td>44</td>
<td>33.9</td>
<td>3.9</td>
<td>6.57</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.8)</td>
<td>(0.5)</td>
<td>(1.12)</td>
<td>(1.9)</td>
</tr>
<tr>
<td>All</td>
<td>117</td>
<td>30.5</td>
<td>3.9</td>
<td>6.19</td>
<td>4.2</td>
</tr>
</tbody>
</table>

**Normal pregnancy**

<table>
<thead>
<tr>
<th>N</th>
<th>BMI (kg/m²)</th>
<th>Fasting glucose (mmol/l)</th>
<th>Peak glucose (mmol/l)</th>
<th>GAUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>25.7</td>
<td>3.7</td>
<td>5.10</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>(3.1)</td>
<td>(0.4)</td>
<td>(0.8)</td>
<td>(1.5)</td>
</tr>
<tr>
<td>55</td>
<td>29.0</td>
<td>3.9</td>
<td>6.00</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(5.2)</td>
<td>(0.5)</td>
<td>(1.32)</td>
<td>(2.0)</td>
</tr>
<tr>
<td>24</td>
<td>27.4</td>
<td>3.8</td>
<td>5.86</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>(3.8)</td>
<td>(0.4)</td>
<td>(0.94)</td>
<td>(2.1)</td>
</tr>
<tr>
<td>94</td>
<td>28.3</td>
<td>3.9</td>
<td>5.83</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>(4.8)</td>
<td>(0.5)</td>
<td>(1.19)</td>
<td>(1.9)</td>
</tr>
</tbody>
</table>

GAUC = glucose area under the curve.

**Fig. 1. Glucose levels during the oral glucose tolerance test in the controls v. pre-eclampsics.**

was similar to that in the normal pregnancy group (3.06 ± 0.15 mmol/l, \( p = 0.85 \)).

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Champagne Sports Resort, KZN 7 - 10 March 2006

The 25th Conference on Priorities in Perinatal Care will be held at Champagne Sports Resort from 7 to 10 March 2006. This a conference that focuses primarily on trying to improve obstetric, midwifery and neonatal care in poorly resourced areas of Southern Africa where populations are dependent on government health services. The emphasis is on the presentation and discussion of original research by public health practitioners, obstetricians, generalists, midwives and neonatologists.

Invited speakers: In the spirit of the 25th anniversary of the conference, and in recognition of the considerable contributions of South Africans to the conference, the Priorities in Perinatal Care Association is proud to announce, the following invited guest speakers: Prof Peter Cooper, Prof James McIntyre, Prof Eddie Mhlanga, Ms Dolly Nyasulu, Prof Bob Pattinson, Prof Alan Rothberg and Prof Dave Woods.

Registration packs are available from the organisers: Roz or Cathy at tel: (012) 373-0825/373-1002, e-mail: matinfru@up.ac.za or the Priorities website: www.perinatalpriorities.co.za

Deadline dates: Abstract submission 13 January 2006 Registration and accommodation booking 17 February 2006 Early and late registration fees apply, kindly contact the organisers for more information.