Monitoring High Risk Pregnancy and Its Outcome

July 21, 2011
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Role of Maternal Human Placental Lactogen (HPL), Estriol (E3) and Ultrasonography in Monitoring High Risk Pregnancy and Its Outcome

Abstract

Human Placental Lactogen (HPL) and Estriol (E3) levels in serum were measured by radioimmunoassay in 50 normal (group I), 50 diabetic (group II) and 50 pre-eclamptic women (group III) at 32 and 36 weeks. Ultrasonography was also done at 16, 18, 32, 36 weeks of pregnancy and immediately before delivery. The mean serum HPL and E2 showed progressive increase with the advance of pregnancy in all groups. However, the pre-eclamptic group showed lower mean serum HPL and E3 concentrations. While diabetic group showed higher serum HPL and E3 concentrations than the control group. There was a positive correlation between birth weight, placental weight and HPL levels at 32 and 36 weeks in all groups and between E3 level and birth weight in pre-eclamptic group only. A significant correlation was found between ultrasonic fetal weight and birth weight in all groups.

Introduction and Aim of the Work

A high risk pregnancy is defined as pregnancy in which there is a risk of a serious adverse outcome in the mother and/or the baby that is greater than the incidence of that outcome in the general population(1).

It has been recognized for many years that hypertension accompanying pregnancy can directly affect both the placenta and the fetus and may cause substantial maternal and fetal morbidity and mortality (2),(3). The incidence of morbidity and unfavourable perinatal outcome are significantly increased in diabetics when compared to non-diabetic pregnancies(3).

Antenatal tests of fetal well-being depend indirectly on changes in fetal and placental physiology(4). Two hormonal tests of fetal well-being are popular; Estriol and Human Placental Lactogen(5). Diagnostic ultrasound has emerged as an important tool for antepartum fetal surveillance(6). The technical and methodological development of diagnostic ultrasound has made possible a direct communication with the fetus(7).

The aim of this work is to study the role of human placental lactogen and free estriol levels in maternal serum and ultrasonography in normal, diabetic and pre-eclamptic pregnancy and their relation to the outcome of pregnancy.

Subjects and Methods

This study involved 150 pregnant women divided into three groups:

**Group I:** (50 cases) were normal pregnant women served as a control group.

**Group II:** (50 cases) were diabetic pregnant women. All patients of this group were insulin-dependant.

**Group III:** (50 cases) were pre-eclamptic pregnant patients. All the patients had been followed up starting from the first trimester and attended at a regular antenatal visits.

A special sheet for each patient was filled. Ultrasonography was done for all the patients at 16, 18, 32, 36 weeks, and immediately before delivery. Fetal weight was estimated by ultrasound according to modified Shepard equation (25).

10 ml of maternal venous blood were collected at 32\textsuperscript{nd} and 36\textsuperscript{th} weeks where radioimmunoassay of HPL and E3 was carried out using the iodinated kits prepared by "Diagnostic Products Corporation, California, USA".

Immediately after delivery, the babies were rescitated and examined, weight and head circumference were recorded and Apgar scores were estimated at one and five minutes. Also the placenta was examined and its weights were recorded.

Results

(links to tables and figures will open in new windows)

Tables 1, 2, 3 and 4 represent the antenatal ultrasonic, biochemical and pregnancy outcome data of...
the studied groups.
A significant correlation was found between ultrasonic fetal weight and birth weight in group I and group III (p<0.05). In group II the correlation was highly significant (p<0.02).
In groups I and III the estimated ultrasonic weight was more then the actual birth weight, while in group II it was always less than the birth weight (tables 2 & 4).
In the three groups the growth curve of ultrasonic fetal weight was within normal range (fig. 1).

Human Placental Lactogen: Serum HPL concentration was found between serum HPL levels and the biparietal diameter (BPD) at 32nd and 36th weeks (p<0.05). Also in this group there was significant correlation between HPL, neonatal head circumference (p<0.05), placental weight (p<0.05) and birth weight (p<0.05), (fig.2 and 3). However, no significant correlation was found between Apgar scores and HPL levels.
In group II, HPL level at 36th weeks was positively correlated with birth weight (p<0.05) (fig.4), placental weight (p<0.002), (fig.5) and inversely correlated with Apgar scores at one and five minutes (p<0.05), (fig.6a & 6b). No significant correlation was found between HPL levels and BPD at 32nd and 36th weeks and head circumference in the newborn.
In group III, a highly significant correlation was found between HPL levels at 36th week and birth weight <0.05, (fig.7). A significant correlation was found between HPL, placental weight (p<0.05), (fig.8), BPD at 32nd and 36th weeks (p<0.002) and Apgar scores at one and five minutes (p<0.05).
Also a significant correlation was found between HPL level at 32nd weeks and neonatal head circumference (p<0.05).

Estriol: The mean E3 levels showed progressive increase with advance of pregnancy (table I).
In group I, a non significant correlation was found between E3 levels and birth weight, placental weight, Apgar scores at five minutes, neonatal head circumference and BPD. A significant correlation between E3 levels and the other studied parameters vs. Birth weight, BPD, placental weight, neonatal head circumference and Apgar scores (p<0.05).
In Group II, There was no significant correlation between E3 levels and the other studied parameters vs. Birth weight, BPD, placental weight, neonatal head circumference and Apgar scores.
In Group III, a significant correlation was found between E3 levels at 32nd and 36th weeks and birth weight (p<0.05) (fig.9). Apgar scores at one and five minutes (p<0.05) (fig.10a & b) and BPD at 36th weeks (p<0.02).
There was no significant correlation between E3 levels and placental weight or BPD at 32nd weeks.

Discussion
There are two main problems in the high risk pregnancy, the first is the fetal weight either large or small for date, the second is the prematurity. Both are accompanied by high perinatal morbidity and mortality (8).
In the present study 150 pregnant women were selected. Fifty cases were normal non complicated pregnancies served as control, 50 cases were diabetic and fifty cases were pre-eclamptic pregnant women.
In this study there were significant correlation between serum level of HPL at 36th weeks and birth weight in normal, pre-eclamptics and diabetic pregnant women. This is in accordance with the finding of Spellacy (9) and kandil et al (10). This correlation could be explained by somatotrophic activity as demonstrated by growth promoting activity, baby weight gain, nitrogen retention and tibial epiphysial growth (11).
The lower mean serum HPL in patients with pre-eclampsia may also be due to impaired placental function.
No significant correlation was found between serum level of free estriol at 36th weeks and birth weight in normal pregnancy. This is in agreement with Kandil et al (12) and against Hay and Lorscheider et al(13). This confliction may be due to fluctation of estriol level from day to day and variation in relation to meal and to uterine contraction(11). There was a positive significant correlation between E3 levels at 36th week and birth weight in pre-eclamptic pregnancy. This finding goes with Kloppers et al(14) but against Kandil et al(12), however, no significant correlation was found in diabetic pregnancy. Similar results were reported by Kandil et al(12)
In all groups, the mean ultrasonic fetal weight and birth weight were within normal range. Human Placental Lactogen can influence both fat and carbohydrate metabolism and may be responsible for the diabetogenic state observed in pregnancy(17), this action involves its direct action on adipose tissues(18). The maternal concentration of HPL is directly related to the amount of viable placental tissue (18,19).
In this study there was a progressive increase in the serum level of HPL from 32nd to 36th weeks in all groups. This was in agreement with previous studies(10,20).
There was lower levels of serum HPL in pre-eclamptic patients compared with normal, while in diabetic patients the serum level of HPL was higher than in normal. Similar results were reported by others(10,11,21).

There was a significant correlation between HPL levels at 36th weeks in pre-eclamptic and diabetic patients and both placental weight and Apgar scores at 1 & 5 minutes... this is against the results reported by Kandil et al(10).

In this study the serum level of E3 showed progressive rising from 32nd to 36th weeks of pregnancy in the studied groups. This finding was in accordance with other studies (12,13,22).

In this study no significant correlation was found between E3 level and birth weight and placental weight in the control group and the diabetic group. This goes with the results reported by Kandil et al(12) and against Allen and Lachelim (22), where they found a correlation between serum E3 level and the mass of trophoblast.

In this study there was a significant correlation between E3 level in normal pregnancy and Apgar score at one minute and insignificant correlation in the first trimester but no correlation in the third trimester.

In diabetic group no significant correlation was found between E3 level and BPD, neonatal head circumference and Apgar scores. This goes with the finding of Kandil et al(12). The incidence of false abnormal values of E3 was high(6,24).

From the presented work we concluded that serum HPL and ultrasonographic assessment of fetal weight appeared to be more accurate tools in assessment of feto-placental well-being in pre-eclamptic and diabetic pregnancies than serum free estriol.

**TABLE 1: Antenatal Data of Studied Groups**

<table>
<thead>
<tr>
<th>DATA</th>
<th>Pre-eclamptic Group (mean + SD)</th>
<th>Normal Group (mean + SD)</th>
<th>Diabetic Group (mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>25.90 + 4.19</td>
<td>27.30 + 4.73</td>
<td>34.50 + 3.55</td>
</tr>
<tr>
<td>t = 1.79</td>
<td>P&gt;0.05 *</td>
<td>t = 3.57 &amp;</td>
<td>P&gt;0.001 *</td>
</tr>
<tr>
<td>Parity</td>
<td>0.02 + 0.041</td>
<td>1.20 + 1.124</td>
<td>2.74 + 2.34</td>
</tr>
<tr>
<td>t = 7.366 &amp;</td>
<td>P&lt;0.002 * t = 3.795 &amp;</td>
<td>P&lt;0.01 *</td>
<td></td>
</tr>
<tr>
<td>Systolic B.P. (mm Hg)</td>
<td>167 + 15</td>
<td>115 + 7</td>
<td>114.70 + 9.45</td>
</tr>
<tr>
<td>t = 22.231 &amp;</td>
<td>P&lt;0.001 * t = 0.180 &amp;</td>
<td>P&gt;0.05 **</td>
<td></td>
</tr>
<tr>
<td>Diastolic B.P. (mm Hg)</td>
<td>99 + 6</td>
<td>76 + 6</td>
<td>75.19 + 12.45</td>
</tr>
<tr>
<td>t = 19.167 &amp;</td>
<td>P&lt;0.001 * t = 0.444 &amp;</td>
<td>P&gt;0.05 **</td>
<td></td>
</tr>
<tr>
<td>Fasting Blood Sugar (mg / dl)</td>
<td>82 + 10.90</td>
<td>81.90 + 10.30</td>
<td>202.85 + 49.22</td>
</tr>
<tr>
<td>t = 0.047 &amp;</td>
<td>P&lt;0.005 ** t = 17.008 &amp; P&lt;0.001 *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant
** Not Significant

**TABLE 2: Ultrasonic Data of Studied Groups**

<table>
<thead>
<tr>
<th>DATA</th>
<th>Pre-eclamptic Group (mean + SD)</th>
<th>Normal Group (mean + SD)</th>
<th>Diabetic Group (mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPD. at 32 weeks</td>
<td>6.978 + 0.454</td>
<td>7.714 + 0.501</td>
<td>8.716 + 0.294</td>
</tr>
<tr>
<td>t = 7.74 &amp;</td>
<td>P&lt;0.002 * t = 12.200 &amp; P&lt;0.001 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPD. at 36 weeks</td>
<td>8.170 + 0.484</td>
<td>8.688 + 0.509</td>
<td>9.542 + 0.347</td>
</tr>
<tr>
<td>t = 5.215 &amp;</td>
<td>P&lt;0.002 * t = 9.804 &amp; P&lt;0.001 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/S Fetal Wt (gm) at 32 weeks</td>
<td>1593.00 + 127.00</td>
<td>1864.00 + 216.00</td>
<td>2289.00 + 513.12</td>
</tr>
<tr>
<td>t = 22.231 &amp;</td>
<td>P&lt;0.001 * t = 5.444 &amp;</td>
<td>P&lt;0.002 *</td>
<td></td>
</tr>
<tr>
<td>U/S Fetal Wt (gm) at 36 weeks</td>
<td>2136.00 + 307.00</td>
<td>2902.00 + 154.00</td>
<td>3452.00 + 326.35</td>
</tr>
<tr>
<td>t = 11.32 &amp;</td>
<td>P&lt;0.001 * t = 10.7 &amp;</td>
<td>P&lt;0.001 *</td>
<td></td>
</tr>
<tr>
<td>U/S Fetal Wt (gm) Immediately before</td>
<td>3060.00 + 452.00</td>
<td>3441.00 + 164.00</td>
<td>4130.00 + 507.00</td>
</tr>
</tbody>
</table>
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* Significant
BPD = Biparietal Diameter
U/S Fetal Wt = Ultrasonic Fetal Weight

delivery 

t=5.50 & P<0.002 * t=9.76 & P<0.001 *

* Significant

** Not Significant

TABLE 3: Biochemical Data of Studied Groups

<table>
<thead>
<tr>
<th>DATA</th>
<th>Pre-eclamptic Group (mean + SD)</th>
<th>Normal Group (mean + SD)</th>
<th>Diabetic Group (mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPL (ng/ml) at 32 weeks</td>
<td>5.55 + 1.63</td>
<td>6.5 + 1.45</td>
<td>7.16 + 1.2</td>
</tr>
<tr>
<td></td>
<td>t=0.09 &amp; P&gt;0.05 **</td>
<td>t=2.6 &amp; P&gt;0.05 *</td>
<td></td>
</tr>
<tr>
<td>HPL (ng/ml). at 36 weeks</td>
<td>8.30 + 1.26</td>
<td>10.3 + 1.5</td>
<td>11.5 + 2.39</td>
</tr>
<tr>
<td></td>
<td>t=6.6 &amp; P&lt;0.01 *</td>
<td>t=3.25 &amp; P&lt;0.01 *</td>
<td></td>
</tr>
<tr>
<td>E3 (ng/ml) at 32 weeks</td>
<td>148.6 + 15.57</td>
<td>150.4 + 26.2</td>
<td>162.1 + 7.32</td>
</tr>
<tr>
<td></td>
<td>t=0.73 &amp; P&gt;0.05 **</td>
<td>t=3.97 &amp; P&lt;0.01 *</td>
<td></td>
</tr>
<tr>
<td>E3 (ng/ml) at 36 weeks</td>
<td>220.5 + 14.9</td>
<td>255.5 + 18.3</td>
<td>271 + 5.2</td>
</tr>
<tr>
<td></td>
<td>t=3.3 &amp; P&lt;0.01 *</td>
<td>t=5.9 &amp; P&lt;0.01 *</td>
<td></td>
</tr>
</tbody>
</table>

* Significant
** Not Significant

TABLE 4: Pregnancy Outcome Data of Studied Groups

<table>
<thead>
<tr>
<th>DATA</th>
<th>Pre-eclamptic Group (mean + SD)</th>
<th>Normal Group (mean + SD)</th>
<th>Diabetic Group (mean + SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (gm)</td>
<td>2964.00 + 500.00</td>
<td>3326.00 + 324.00</td>
<td>4259.00 + 620.70</td>
</tr>
<tr>
<td></td>
<td>t=4.296 &amp; P&lt;0.01 *</td>
<td>t=9.431 &amp; P&lt;0.001 *</td>
<td></td>
</tr>
<tr>
<td>Placental Weight (gm)</td>
<td>391.00 + 96.42</td>
<td>540.00 + 63.00</td>
<td>735.00 + 156.85</td>
</tr>
<tr>
<td></td>
<td>t=9.148 &amp; P&lt;0.001 *</td>
<td>t=8.158 &amp; P&lt;0.001 *</td>
<td></td>
</tr>
<tr>
<td>Head Circumference (cm)</td>
<td>32.41 + 1.54</td>
<td>33.51 + 1.36</td>
<td>34.83 + 0.96</td>
</tr>
<tr>
<td></td>
<td>t=3.788 &amp; P&lt;0.01 *</td>
<td>t=5.623 &amp; P&lt;0.002 *</td>
<td></td>
</tr>
<tr>
<td>APGAR Scores (1 minute)</td>
<td>4.00 + 1.40</td>
<td>5.00 + 1.00</td>
<td>3.42 + 1.10</td>
</tr>
<tr>
<td></td>
<td>t=8.3 &amp; P&lt;0.001 *</td>
<td>t=12.18 &amp; P&lt;0.001 *</td>
<td></td>
</tr>
<tr>
<td>APGAR Scores (5 minutes)</td>
<td>6.00 + 1.50</td>
<td>8.00 + .90</td>
<td>5.42 + 1.57</td>
</tr>
<tr>
<td></td>
<td>t=7.69 &amp; P&lt;0.002 *</td>
<td>t=9.55 &amp; P&lt;0.001 *</td>
<td></td>
</tr>
</tbody>
</table>

* Significant
** Not Significant
Figure 1. Ultrasonic Growth Curve of Different Groups

Figure 2. HPL at 36 weeks correlated to birth weight in control group
\[ r = 0.59 \quad P < 0.002 \text{ (significant)} \]
Figure 3: HPL at 36 weeks correlated to placental weight in control group  
\[ r = 0.65 \, P < 0.05 \, \text{(significant)} \]

Figure 4: HPL at 36 weeks correlated to birth weight in diabetic group  
\[ r = 0.84 \, P < 0.002 \, \text{(significant)} \]
Figure 5: HPL at 36 weeks correlated to placental weight in diabetic group
\[ r = 0.79 \quad P < 0.002 \text{ (significant)} \]

Figure 6a: HPL at 36 weeks correlated to Apgar score at one minute in diabetic group
\[ r = 0.29 \quad P < 0.05 \text{ (significant)} \]
Figure 6b: HPL at 36 weeks correlated to Apgar score at five minutes in diabetic group
\[ r = 0.54 \ P < 0.05 \text{ (significant)} \]

Figure 7: HPL at 36 weeks correlated to birth weight in pre-eclamptic group
\[ r = 0.75 \ P < 0.02 \]
Figure 8: HPL at 36 weeks correlated to the weight of placenta in pre-eclamptic group. 
\[ r = 0.64 \; P < 0.05 \text{ (significant)} \]

Figure 9: Estriol at 36 weeks correlated to birth weight in pre-eclamptic group. 
\[ r = 0.51 \; p < 0.05 \text{ (significant)} \]
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Figure 10a: estriol at 36 weeks correlated to Apgar score at one minute in pre-eclamptic group  \( r = 0.33 \ P < 0.05 \)

Figure 10b: estriol at 36 weeks correlated to Apgar score at five minutes in pre-eclamptic group  \( r = 0.42 \ P < 0.05 \)

References:


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