EVALUATION OF UROCYTOGRAM AS A METHOD OF HORMONAL ASSESSMENT IN NORMAL AND ABNORMAL PREGNANCY: A COMPARATIVE STUDY OF URINARY AND VAGINAL CYTOLOGY AND CYTOCHEMISTRY

by

R. Mitra,* M.S., D.G.O.,

V. L. Lahari,** M.D., M.A.M.S., M.I.A.S.

and

M. Chowdhary,*** M.B.B.S., D.G.O.

Assessment of hormonal function in pregnancy is one of the most important methods of diagnosis of pregnancy at term, but this method has not proved to be of much reliability. The evaluation of urocytogram has got an immense importance for obstetricians as well as for would be mothers.

The present study was undertaken with the following aims:

1. To establish the normal pattern of urocytogram at full term pregnancy and their comparative value with vaginal smear.

2. To establish the hormone related changes in lipids and glycogen of urinary cells in relation to the vaginal cytogram and urocytogram.

3. To study the changes in urocytogram of lipids and contents of urinary cells in abnormal pregnancy.

Material

The present study includes the estimation of urocytogram and vaginal cytology, glycogen, fats and lipids in urinary cells in following number of cases under different heads as follows:

A. Normal healthy pregnant females
   a. Normal third term pregnancy 15
   b. Normal second term pregnancy  5
   c. Normal first term pregnancy  10
   d. Normal pre-term pregnancy  7
   e. Normal post-term pregnancy  5

Table I shows comparative values in mean indices between normal third pregnancy, pre-eclampsia, intra-uterine foetal death, post-maturity and post-partum.

Maturation Index

The superficial cells show a prominent increase in intrauterine foetal death and postpartum cases, while there is a slight increase in pre-eclampsia and postmaturity as compared to normal third term pregnancy. The parabasal cells show an increase in postpartum and postmaturity cases as compared to normal third term pregnancy. The difference in intrauterine foetal death in vaginal smear and urocytogram is more or less same, while it is

*Reader in Obst. & Gynec.
**Professor of Pathology.
***Resident Gynaecological Officer, G. S. V. M. Medical College, Kanpur.
Various indices: $M_1 = \text{crowding cell index}, N_1 = \text{Navicular cell}$, $M_2 = \text{Maturity index}, \text{El} = \text{Conspicuous index}, \text{Kl} = \text{Karyopyknotic index}$.

$\text{El} = \text{Follicular index}$.

$\text{CCi} = \text{Column cells}$, $\text{NC} = \text{Navicular cells}$.

**TABLE I**

<table>
<thead>
<tr>
<th>Variation in Mean Indices Between 3rd Trimester and at Term Pregnancy, Pre-eclampsia, Intrauterine Death, Postmaturity, and Postpartum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal pregnancy 3rd trimester; $\text{El} = 0.94 \pm 0.2$; $\text{Kl} = 0.76 \pm 0.9$; $\text{M1} = 0.49 \pm 1.1$; $\text{CCi} = 0.96 \pm 1.2$.</td>
</tr>
<tr>
<td>Pre-eclampsia $0.90 \pm 11.2$; $0.90 \pm 1.8$; $0.90 \pm 2.8$; $0.90 \pm 1.9$; $0.90 \pm 6.4$; $0.90 \pm 5.6$; $0.90 \pm 4.4$; $0.90 \pm 3.1$; $0.90 \pm 2.1$; $0.90 \pm 1.0$; $0.90 \pm 0.1$.</td>
</tr>
<tr>
<td>Intrauterine death $0.44 \pm 1.2$; $0.44 \pm 3.2$; $0.44 \pm 4.2$; $0.44 \pm 5.4$; $0.44 \pm 6.4$; $0.44 \pm 7.2$; $0.44 \pm 8.8$; $0.44 \pm 10.0$.</td>
</tr>
<tr>
<td>Postmaturity $0.78 \pm 1.6$; $0.78 \pm 7.6$; $0.78 \pm 10.0$; $0.78 \pm 14.0$; $0.78 \pm 20.0$; $0.78 \pm 24.0$; $0.78 \pm 35.0$; $0.78 \pm 42.0$; $0.78 \pm 44.0$; $0.78 \pm 50.0$.</td>
</tr>
<tr>
<td>Postpartum $0.44 \pm 1.2$; $0.44 \pm 3.2$; $0.44 \pm 4.2$; $0.44 \pm 5.4$; $0.44 \pm 6.4$; $0.44 \pm 7.2$; $0.44 \pm 8.8$; $0.44 \pm 10.0$.</td>
</tr>
</tbody>
</table>

**Difference from Normal Third Trimester Significant at $P = 1\%$.**
more marked in the vaginal smear in postpartum cases.

Eosinophilic Index

It is approximately the same in normal pregnancy, pre-eclampsia and postmaturity, but there is prominent increase in cases of intrauterine foetal death and in postpartum cases. The increase is more marked in urocytogram than in vaginal smear.

Cornification Index

There is an increase in pre-eclampsia, postmaturity, intrauterine foetal death and in postpartum cases as compared to normal pregnancy. The increase is more marked in cases of intrauterine foetal death and in postpartum cases in vaginal cytology. The urocytogram shows a remarkable increase in cases of intrauterine foetal death and to some extent in postpartum cases.

Folding Index

This is less in cases of intrauterine foetal death and in postpartum cases as compared to normal pregnancy in both vaginal smear and urocytogram.

Crowding Cell Index

It shows marked increase in cases of intrauterine death and in postpartum cases as compared to normal third term pregnancy.

Navicular Cells

The urocytogram shows marked decrease in navicular cells in cases of intrauterine death and to some extent in postpartum cases. This decrease is less marked in vaginal smear. All these differences are significant statistically at 1% level.

Table II shows that there is marked fall in the percentage of cells with coarse lipid granules in cases of intrauterine death and in postpartum cases as compared to normal third term pregnancy. This fall is more marked in postpartum cases.

There is no change in percentage of fine lipid granules. The findings are parallel to urocytogram.

These differences are significant statistically (P = 1) in cases of intrauterine death and in postpartum cases compared to normal third term pregnancy.

**TABLE II**

*Shows a Comparison of Mean Percentage of Masked Lipids Between 3rd Term Pregnancy, Pre-eclampsia, Postmaturity, Intrauterine Foetal Death and Post-partum with M1 in urinary cells*

<table>
<thead>
<tr>
<th>Lipid granules</th>
<th>Normal 3rd trimester pregnancy</th>
<th>Pre-eclampsia</th>
<th>Postmaturity</th>
<th>UD</th>
<th>Post-partum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of cells with coarse granules</td>
<td>68 ± 3.9</td>
<td>60 ± 6.6</td>
<td>38 ± 5.8</td>
<td>26* ± 3.4</td>
<td>8* ± 2.0</td>
</tr>
<tr>
<td>% of cells with fine granules</td>
<td>2 ± 0.4</td>
<td>4 ± 0.5</td>
<td>4 ± 0.7</td>
<td>3 ± 0.4</td>
<td>5 ± 0.6</td>
</tr>
<tr>
<td>Urocytogram</td>
<td>6 : 90 : 4</td>
<td>0 : 90 : 10</td>
<td>10 : 81 : 8</td>
<td>0 : 50 : 50</td>
<td>25 : 45 : 30</td>
</tr>
<tr>
<td></td>
<td>± 11.2 ± 6.15</td>
<td>± 11.4</td>
<td>±1.9 ± 0.9</td>
<td>± 6.2 ± 7.2</td>
<td>± 2.8 ± 3.1</td>
</tr>
</tbody>
</table>

*Difference significant at 1% level from normal.*
TABLE III

Shows a Comparison of Mean Percentage of Lipofucsin in Urinary Cells in Normal Third Term Pregnancy, Pre-eclampsia, Postmaturity, Intrauterine Foetal Death and Postpartum With Urocytogram

<table>
<thead>
<tr>
<th></th>
<th>Normal third term pregnancy</th>
<th>Pre-eclampsia</th>
<th>Postmaturity</th>
<th>I UD</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of cells positive</td>
<td>42</td>
<td>22*</td>
<td>30*</td>
<td>20*</td>
<td>Negative</td>
</tr>
<tr>
<td>SD ± 5.2</td>
<td>± 2.3</td>
<td>± 3.2</td>
<td>± 5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urocytogram</td>
<td>0 : 96 : 4</td>
<td>0 : 90 : 10</td>
<td>10 : 81 : 9</td>
<td>0 : 50 : 50</td>
<td>25 : 45 : 30</td>
</tr>
<tr>
<td>± 11.2 ± 0.5</td>
<td>± 11.4 ± 1.8</td>
<td>± 1.9 ± 9.9</td>
<td>± 6.8 ± 7.2</td>
<td>± 2.8 ± 5.1</td>
<td>± 3.2</td>
</tr>
</tbody>
</table>

*Difference significant at P = 1

Percentage of lipofucsin positive cells normal third term pregnancy. In post-decreases under every head compared to partum it is negative.

TABLE IV

Shows the Comparison of Mean Percentage of Neutral Fat in Urinary Cells of Normal 3rd Term Pregnancy, Pre-eclampsia, Intrauterine Death, Postmaturity and Postpartum.

<table>
<thead>
<tr>
<th></th>
<th>Normal third trimester pregnancy</th>
<th>Pre-eclampsia</th>
<th>I UD</th>
<th>Postmaturity</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of positive cells</td>
<td>Neg</td>
<td>Neg</td>
<td>Neg</td>
<td>Neg</td>
<td>6.8</td>
</tr>
<tr>
<td>Urocytogram</td>
<td>0 : 96 : 4</td>
<td>0 : 90 : 10</td>
<td>10 : 81 : 9</td>
<td>25 : 45 : 30</td>
<td></td>
</tr>
<tr>
<td>± 11.2 ± 0.5</td>
<td>± 11.4 ± 1.8</td>
<td>± 1.9 ± 9.9</td>
<td>± 6.8 ± 7.2</td>
<td>± 2.8 ± 5.1</td>
<td>± 3.2</td>
</tr>
</tbody>
</table>

Only in postpartum cases, the cells are positive for neutral fat in urinary cytology. This is a significant difference.

TABLE V

Shows a Comparison of Mean Percentage of PAS Material in Urinary Cells in Normal Third Term Pregnancy, Pre-eclampsia, Postmaturity, Intrauterine Death and Postpartum with Urocytogram

<table>
<thead>
<tr>
<th></th>
<th>Normal third term pregnancy</th>
<th>Pre-eclampsia</th>
<th>Postmaturity</th>
<th>Intrauterine death</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of cells positive</td>
<td>76</td>
<td>70</td>
<td>61*</td>
<td>30*</td>
<td>28*</td>
</tr>
<tr>
<td>± 8.2</td>
<td>± 7.9</td>
<td>± 6.9</td>
<td>± 3.4</td>
<td>± 3.2</td>
<td></td>
</tr>
<tr>
<td>Urocytogram</td>
<td>0 : 96 : 4</td>
<td>0 : 90 : 10</td>
<td>10 : 81 : 9</td>
<td>0 : 50 : 50</td>
<td>25 : 45 : 30</td>
</tr>
<tr>
<td>± 11.2 ± 0.5</td>
<td>± 11.4 ± 1.8</td>
<td>± 1.9 ± 9.9</td>
<td>± 6.8 ± 7.2</td>
<td>± 2.8 ± 5.1</td>
<td>± 3.2</td>
</tr>
</tbody>
</table>

* Difference from normal pregnancy significant at P = 1

Percentage of PAS material positive cells decreases in postmaturity but there is marked decrease in intrauterine foetal death and postmaturity. These differences in postmaturity, intrauterine foetal death and postpartum are significant statistically from 3rd term pregnancy.
Discussion

The urocytogram, that is the study of endocrine status via the urinary cytology, was first described by Biot and Beltran (1944), but it did not receive much attention. Its utility in clinical practice has yet to be popularised.

The present work was to establish the normal values of the urocytogram at third trimester pregnancy and postpartum and to compare the changes occurring in abnormal pregnancies in cellular lipids and polysaccharides which are known to be affected by sex hormones.

Urocytogram during 3rd trimester of pregnancy shows intermediate cells 96% ± SD 11.2, El & K1 17% ± SD 2.8 and 10% ± SD 2.0 respectively. The navicular cells are maximum, the mean value of which is 75% ± SD 8.8. The findings of urocytogram are more or less the same as in vaginal cytology.

In the present study smear of normal pregnancy mainly consisted of large number of intermediate cynophilic cells and no parabasal cells and there was low value of eosinophilic and karyopyknotic indices upto 37th week of pregnancy. Lencioni 1969 reported the same findings along with few parabasal cells present in the smear.

The superficial eosinophilic cells were present upto 4%, while in Lencioni (1969) series they were 1% upto 37th week of pregnancy.

The smear also showed the increased desquamation, cellular clustering, folding and navicular cells. The findings of the present study are comparable with the findings of Lencioni 1969.

According to Lencioni there is no increase in E1 in urocytogram during the last three weeks of pregnancy, while in the present study the percentage was with the mean value of 4% ± SD 0.5.

The findings of urocytogram correspond with the findings reported by Pundel and Van Meensel (1961) in vaginal smears consisting of low value of superficial eosinophilic cells throughout pregnancy.

The urocytogram in pre-eclampsia showed a similar pattern to that of normal 3rd trimester pregnancy except that it showed a decrease in navicular cells with the mean value of 70% ± SD 8.2 to 46% ± SD 5.4.

Wood et al in 1961 reported that in pre-eclampsia the grading of smear decreases and the cornification index increases in comparison to normal pregnancy. They also reported a normal vaginal smear in a few cases. Thus, it appears that in some cases of pre-eclampsia a high oestrogen level may be present but conclusion cannot be drawn due to small number of cases in this series.

The findings in present study in post-maturity showed an increase in parabasal cells with a mean value of 10% ± SD 1.9 compared to 0% of normal pregnancy and decrease in navicular cells with a mean value of 46% ± SD 6.1 from a mean value of 76% ± SD 8.8 in normal pregnancy in the urocytogram. Vaginal cytology showed an increase in parabasal cells with a mean value of 60% ± SD 1.9 from 0% of normal 3rd term pregnancy and K1 with a mean value of 20% ± SD 3.1 from a mean value of 6% ± SD 2.8. There was no difference in K1 value in normal pregnancy and postmaturity in urocytogram.

The urocytogram in intrauterine foetal death showed an increase in superficial cells and El with a mean value of 50% ± SD 7.2 as against 4% ± SD 6.9, 50% ± SD 4.6 as against 10% ± SD 2.6 in normal 3rd term pregnancy, respectively.
Urocytogram shows a fall in the mean value of F1, CC1 and navicular cells, F1 58% as compared to 85% ± SD 7.8, CC1 55% ± SD 7.2, as against 70% ± SD 4.8 navicular cells, 25% ± SD 3.2 as compared to 70% ± SD 8.2 in 3rd term pregnancy, respectively. The findings of vaginal cytology showed the same pattern. Similar findings in vaginal cytology has been reported by Mukerjee et al in 1970.

In post-partum cases the findings show an increase in the mean value of superficial cells 30% ± SD 3.2, E1 56% ± SD 5.9, K1 30% ± SD 3.2 as compared to the value of 4% ± SD 0.9, E1 10% ± SD 2.0, K1 10% ± SD 1.7 normal third term pregnancy and show a fall in the mean value of F1 55%, CC1 35% ± SD 4.8 and navicular cells 9% ± SD 1.0 as compared to F1 85% ± SD 7.8, CC1 70% ± SD 4.8 and navicular cells 70% ± SD 8.2 in normal third term pregnancy.

All these differences are significant statistically.

Urocytogram study of coarse lipid granules between 3rd term pregnancy and abnormal pregnancies showed a fall in pre-eclampsia, the mean value being 60% ± SD 6.6, in postmaturity 58% ± SD 5.3, in intrauterine foetal death 26% ± SD 3.4 and in postpartum 8% ± SD 2.8 compared to 68% ± SD 5.9 of the 3rd term pregnancy. The differences are significant statistically in cases of intrauterine foetal death and postpartum cases only.

The comparative study of lipofuscin in urinary cells between abnormal pregnancies and normal 3rd term pregnancy showed a fall from a mean value of 42% ± SD 5.2 in normal 3rd term pregnancy, it went down to 22% ± SD 2.3 in pre-eclampsia, 30% ± SD 3.2 in postmaturity, 20% ± SD 5.4 in intrauterine death and became negative in postpartum cases. These differences are significant statistically in all the abnormal pregnancies.

The study of PAS positive cells in urinary cells in normal 3rd term pregnancy versus abnormal pregnancies showed a fall. The percentage of positive cells with a mean value of 70% ± SD 7.9 in pre-eclampsia, 61% ± SD 6.9, in postmaturity, 30% ± SD 3.4, in cases of intrauterine death and 28% ± SD 3.2 in postpartum cases compared to 76% ± SD 8.2 in normal 3rd term pregnancy. All these differences are significant statistically compared to normal 3rd term pregnancy.

Papanicolaou (1948) for the first time reported glycogen loaded navicular cells in the exfoliated cells of human urine.

The alteration in these chemical constituents in the cells in response to hormone effects reveals the great panorama of the cellular targets of hormone effects. It is the opinion of many endocrinologists (Williams 1960) that hormones do not produce new biochemical reactions but influence the rate and intensity of reactions indirectly. Many of them may influence significantly the metabolism of carbohydrate, protein, fat, minerals and water.

Conclusion

1. In pre-eclampsia the mean value of navicular cells is statistically significant as compared to 3rd term pregnancy. The findings are parallel to vaginal cytology. Thus, it appears that in some cases of pre-eclampsia a high oestrogen level may be present but conclusions cannot be drawn due to small number of cases in this series.

2. The mean value of parabasal and navicular cells in urocytogram are significant statistically in postmaturity.
3. In postmaturity the K1 with a mean value of 20% ± SD 3.1 in vaginal cytology is found to be significant statistically when compared with the 3rd term pregnancy 6% ± SD 2.0.

4. In intruterine foetal death the mean value of superficial and navicular cells are found to be a significant statistically than the 3rd term pregnancy. The finding of vaginal cytology are parallel to urocytogram.

5. In postpartum the mean value of parabasal, superficial and navicular cells are found to be significant statistically than the normal 3rd term pregnancy. Findings are similar in vaginal cytology.

6. The percentage of coarse lipid granules falls in abnormal pregnancies as compared to normal 3rd term pregnancy. The differences are significant statistically.

7. The study of lipofuscin in urinary cells are significant statistically in all the abnormal pregnancies as compared to normal 3rd term pregnancy.

8. The study of PAS positive material in abnormal pregnancies are significant statistically as compared to normal 3rd term pregnancy.

9. This study of urocytogram shows cell pattern parallel to those reflected in the vaginal smear under the influence of oestrogen and progesterone.

References