EVALUATION OF URINARY DILUTING AND CONCENTRATING ABILITIES IN HEALTHY PREGNANT WOMEN BY OSMOLAR AND FREE WATER CLEARANCES

GÜLAY LOGOGLU
FATMA T. ÖZGÜNEN
AYSE DOGAN

SUMMARY: Osmolar and free water clearances were evaluated during the first trimester Cn=11, second trimester (n=17) and the third trimester (n=27) of healthy pregnant women. Compared with non-pregnant values, no significant differences were determined in both of these clearance levels, indicating that urinary diluting and concentrating abilities are not impaired during normal pregnancy.

Key Words: Pregnancy, osmolar clearance, free water clearance.

INTRODUCTION

Although it's known that urinary diluting and concentrating abilities are not impaired during normal pregnancy, osmolar and free water clearances (c_{osm} and C_{H2O}) are affected by gestational postural changes (4, 6).

In pregnant women, especially in their third trimester, urine flow, sodium excretion and C_{H2O}) levels decrease significantly, whereas all these three parameters increase sharply when lying on lateral recumbent position. These changes are due to some hormonal and reflex factors, in addition to the mechanical effect of the gravid uterus on large vessels. Pregnant women retain water during daytime due to upright position, but they excrete this water at nights due to lateral recumbent position. This diurnal rhythm is in contrast to that seen in non-pregnants (1-4, 6).

In this study, we aimed to evaluate the osmolar and free water clearances in normal gestation, and to determine the causes of controversial findings, which may be due to normal gestational changes and postural effects.

MATERIALS AND METHODS

Subjects

Healthy pregnant women in their I. trimesters (n=11), and II. trimesters (n=17) were selected from Obstetrics Outpatient Clinic of Çukurova University Medical Center, who were examined periodically during their pregnancies. Healthy pregnants in their III. trimesters (n=27) were selected from Obstetrics Clinic of the same center and were hospitalized for normal deliveries.

From Departments of Physiology, Obstetrics and Gynecology and Central Laboratories of Çukurova University, Medical School, Adana, Türkiye.

Non-pregnant controls (n=27) were selected from Gynecology Clinic of the same center, who were hospitalized because of infertility problems or for being performed tubal ligation.

Medical histories, physical examinations and laboratory results were evaluated. All the subjects, who were suspected of toxemia or who had hypertension, diabetes mellitus, cardiac disorders, renal and/or urinary system disturbances and ones having systolic blood pressure above 140 and diastolic above 80 mmHg, were excluded from this study. Clinical details of the pregnant and non-pregnant groups are demonstrated in Table 1.

All the subjects were evaluated for their blood glucose, BUN and plasma creatinine, uric acid Na^+, K^+, Ca^{++} and phosphate levels; ones deviating from normal were also not included in this study.

Table 1: Clinical details of the pregnant and non-pregnant groups (mean±SE).

Group	Age (year)	Parity	Weight (kg)	Height (cm)	* BP (mmHg)	
					Systolic	Diastolic
I.Trim n=11	28.36 ±1.13	1.91 ±0.61	68.27 ±4.50	160.27 ±1.13	112.27 ±4.17	72.73 ±3.26
II.Trim n=17	25.47 ±1.18	2.0 ±0.69	63.56 ±2.66	158.24 ±1.56	109.41 ±2.31	69.71 ±1.63
III.Trim n=27	28.48 ±1.0	1.52 ±0.33	70.63 ±1.72	159.93 ±0.80	13.33 ±2.6	70.37 ±1.73
Nonpregn. n=27	29.41 ±0.87	3.19 ±0.58	62.78 ±1.63	161.48 ±1.19	16.67 ±2.07	71.11 ±1.63
Total n=82	28.15 ±0.54	2.22 ±0.28	66.26 ±1.17	160.13 ±0.60	13.48 ±1.33	70.79 ±0.94
Min. value	16	0	46	147	90	50
Max. value	39	12	99	175	140	80

Materials and Methods

In order to obtain osmolar and free water clearance values, clearance tests were applied in two periods, by using the standard method (5, 7). The first urine collection period (I. period) was started at 09.00 a.m. in the morning and terminated at 11.00 a.m., and the second urine collection period (II. period) was started at 13.00 p.m. in the afternoon and terminated at 15.00 p.m., each period lasting for two hours. In the mid-portion of these periods, blood samples were taken for analysis of osmolality.

All the subjects were held in their normal daily activities, and were not kept in a specific posture throughout the test periods.

Osmolar and free water clearances ($U_x.V/P_x$) were determined in the I. and the II. periods, and their means were calculated to evaluate the mean clearance values.

Plasma and urine osmolalities were measured by using the freezing point osmometer (Precision Systems; Microosmette^{TM}. Mod. Nu: 5004-F. Series Number: P12130).

The results were analyzed statistically by means of one way ANOVA test (Statistical Graphics Co, 1988 StSC, Version 3.0).

RESULTS

Osmolar Clearance (C_{osm})

Osmolar clearance values are demonstrated in Table 2.

Table 2: Osmolar clearance values of the pregnant and non-pregnant groups (Mean±SE).

Group	C_{osm1} (ml/min)	C_{osm2} (ml/min)	Mean C_{osm} (ml/min)
I.Trim n=11	1.6±0.32	1.49±0.2	1.58±0.25
II.Trim n=17	1.52±0.15	1.43±0.11	1.49±0.1
III.Trim n=27	1.60±0.13	1.38±0.16	1.51±0.13
Nonpregn. n=27	1.57±0.19	1.39±0.16	1.50±0.13
Total n=82	1.58±0.09	1.41±0.08	1.51±0.07
	F=0.04 p=0.99>0.05	F=0.07 p=0.98>0.05	F=0.05 p=0.99>0.05

Compared with non-pregnant values, no significant differences were determined in C_{osm1}, C_{osm2} and mean C_{osm} levels (Table 2; p>0.05). ("1" and "2" numbers seen in all abbreviated clearance expressions demonstrate the clearances in the first and the second periods, respectively).

Free Water Clearance (C_{H2O})

Free water clearance values are demonstrated in Table 3.

Table 3: Free water clearance values of the pregnant and non-pregnant groups (Mean±SE).

Group	C_{H2O-1} (ml/min)	C_{H2O-2} (ml/min)	Mean C_{H2O} (ml/min)
I.Trim n=11	-0.42±0.22	-0.20±0.19	-0.32±0.21
II.Trim n=17	-0.20±0.22	-0.36±0.14	-0.30±0.15
III.Trim n=27	-0.36±0.15	-0.30±0.14	-0.33±0.13
Nonpregn. n=27	-0.24±0.24	-0.29±0.17	-0.27±0.18
Total n=82	-0.29±0.11	-0.30±0.08	-0.30±0.08
	F=0.18 p=0.91>0.05	F=0.10 p=0.96>0.05	F=0.03 p=0.99>0.05

Compared with non-pregnant values, no significant differences were determined in C_{H2O-1}, C_{H2O-2} and mean C_{H2O} levels (Table 3; p>0.05).

DISCUSSION

Because of the marked gestational postural effects on osmolar and free water clearance values, all subjects included in this study were held in their normal daily activities and were not kept in a specific position throughout the test periods. Due to the same reasons, urine collection periods were limited to two hours (1-4, 6).

Osmolar clearance

No statistically significant differences were determined in osmolar clearance values between the pregnant and non-pregnant groups (Table 2; p>0.05). These findings were attributed to short urine collection periods, so that pregnant groups were not affected by positional changes.

As also determined by other investigators, osmolar clearance values do not differ in normal gestation if the clearance tests are applied in appropriate conditions (1, 2, 6).

Free water clearance

Compared with non-pregnant values, no significant differences were determined in mean C_{H2O} values, all of which were observed to be negative in all groups (Table 3; p>0.05).

These findings can be attributed to short clearance periods, so that pregnant groups were not affected by positional changes (3).

Our results are similar to those determined in same other studies; C_{H2O} levels decrease significantly in supine or upright positions especially in the III. trimester (1, 4), but when the clearance tests are applied in proper conditions, water excretion and free water clearances do not differ in normal pregnancy (6).

As determined by osmolar and free water clearances, we conclude that urinary diluting and concentrating abilities are not impaired during normal gestation.

REFERENCES

1. Assali NS , Dignam WJ , Dasgupta K : Renal Function in Human Pregnancy. J Lab Clin Med, 54:394-408, 1959.

2. Kaitz AL : Urinary Concentrating Ability in Pregnant Women With Asymptomatic Bacteriuria. J Clin Invest, 40:1331-1338, 1961.

3. Lindheimer MD, Katz AI : The Renal Response to Pregnancy in Kidney, Ed by BM Brenner, FC Jr. Rector, Philadelphia, Saunders, 1981.

4. Lindheimer MD, Weston PV : Effect of Hypotonic Expansion on Sodium, Water and Urea Excretion in Late Pregnancy: The Influence of Posture on These Results J Clin Invest, 48:947-955, 1969.

5. Orten JM , Neuhaus OW : Biochemistry, Eighth ed, Saint Louis, The CV Mosby Company, 1970.

6. Roxe DM : Renal Disease in Pregnancy and JM Davison, Lindheimer MD : Hypertension in Pregnancy. In Maternal and Fetal Medicine, Gynecology and Obstetrics, Vol 3, Ed by R Depp, DA Eschenbach, JJ Sciarra, Revised ed, Harper and Row Publ, Philadelphia, 1987.

7. Yenson M : Uygulamali Klinik Biyokimya Çalismalari. Istanbul, Sulhi Garan Matbaasi Koll Sti, 1977.

Correspondence:
Gülay LOGOGLU
Çukurove Üniversitesi,
Tip Fakültesi,
Psikoloji Bölümü
Adana, TÜRKIYE.