CHANGES IN POTASSIUM CLEARANCE (C_{K^+}) AND PLASMA K^+ (PK^+) LEVELS IN NORMAL PREGNANCY

GÜLAY LOGOGLU
FATMA T. ÖZGÜNEN
TUNCAY ÖZGÜNEN
AYSE DOGAN

SUMMARY: Potassium clearances and plasma K^+ levels were evaluated during the I. trimester (n=11), II. trimester (n=17) and the III. trimester (n=27) of healthy pregnant women. The highest clearance values were determined in the III. trimester, and plasma K^+ levels were slightly lower in the pregnant groups, but compared with non-pregnant values, no significant differences were determined in both of these parameters.

Key Words: Pregnancy, potassium clearance, plasma potassium.

INTRODUCTION

In spite of some theoretical hypokalemic changes in normal pregnancy such as increased plasma levels of aldosterone and other potent mineral corticoids, and gestational hyperinsulinemia which shifts K^+ into ICF, 300-350 meq of potassium is retained throughout pregnancy, most of which is distributed in fetal and mammary tissues, uterus, and placenta. The tendency to retain potassium in normal pregnancy is attributed to sodium which is found abundantly in tubular fluid, and also to increased plasma levels of progesterone. There are significant evidence that hypokalemia returns to normal when severe K^+ depleting disturbances are accompanied by pregnancy (3, 5, 6).

In contrast to these findings, some authors conclude that plasma K^+ level decreases during pregnancy, and K^+ excretion is not influenced by gestational postural effects (1, 2, 4, 8).

Plasma potassium levels have to be evaluated during preeclampsia which is accompanied by decreased GFR (9), and also during pregnancies associated with some renal disturbances. In order to make reliable conclusions during these states, renal handling of potassium in normal pregnancy must be known. No detailed studies were available in the literature about K^+ clearance during pregnancy. In our study, we aimed to evaluate potassium clearance and plasma K^+ level during normal gestation.

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

MATERIALS AND METHODS

Subjects

The control group consisted of normal pregnant women in their I. (n=11) and ll. (n=17) trimesters coming to the outpatient department for periodical examinations and of the III. trimester (n=27) hospitalized for deliveries.

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 anamneses, physical examinations and results of laboratory analyses 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 not included in our 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^+, Ca^{++} and phosphate levels; ones deviating from normal were also not included in this study.

Materials and methods

In order to obtain K^+ clearance values, clearance tests were applied in two periods, by using the standard method (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 K^+ analysis.

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

Potassium clearance ($U_K{}^+.V/pK^+$) were determined in the I. and the II. periods ($C_K{}^+{}_1$ and $C_K{}^+{}_2$), and their means were calculated to evaluate the mean $C_K{}^+$ values.

K^+ levels in plasma and urine were measured by using the flame photometer (Corning 455).

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

RESULTS

Potassium clearances and plasma potassium levels are demonstrated in Table 2.

Compared with non-pregnant values, no significant differences were determined in $C_K{}^+{}_1$, $C_K{}^+{}_2$ and mean $C_K{}^+$ levels (Table 2; p>0.05).

The highest mean $C_K{}^+$ value was observed in the III. trimester pregnant group ($C_K{}^+{}_1$: Potassium Clearance in the I. Period; $C_K{}^+{}_2$: Potassium Clearance in the II. Period).

Mean pK^+ levels were determined to be slightly lower in the pregnant groups, but this difference was also non-significant (Table 2; p>0.05).

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

Group	Age (years)	Parity	Weight (kg)	Height (cm)	Blood pressure (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	113.33 ±2.6	70.73 ±1.73
Non-pregnant n=27	29.41 ±0.87	3.19 ±0.58	62.78 ±1.63	161.48 ±1.19	116.67 ±2.07	71.11 ±1.63
Total n=82	28.15 ±0.54	2.22 ±0.28	66.26 ±1.17	169.13 ±0.60	113.48 ±1.33	70.79 ±0.94

Table 2: Potassium clearances and mean plasma potassium levels *(pK^+) of the pregnant and non-pregnant groups (mean ± SE).

Group	$C_K{}^+{}_1$ (ml/min)	$C_K{}^+{}_2$ (ml/min)	Mean $C_K{}^+$ (ml/min)	pK^+ (meq/lt)
I. Trim n=11	6.65 ±1.87	6.28 ±1.52	6.49 ±1.64	3.99 ±0.15
II. Trim n=17	5.58 ±0.45	6.20 ±0.72	5.91 ±0.46	3.93 ±0.10
III. Trim n=27	7.30 ±0.65	6.70 ±0.83	7.03 ±0.70	3.97 ±0.10
Non-pregnant n=27	7.42 ±0.94	6.19 ±0.91	6.82 ±0.85	4.01 ±0.09
Total n=82	6.89 ±0.46	6.37 ±0.47	6.66 ±0.43	3.98 ±0.05
*CV (%)	60.52	66.88	58.26	11.81
	F=0.80 p=0.50>0.05	F=0.08 p=0.97>0.05	F=0.31 p=0.82>0.05	F=0.13 p=0.94>0.05

* pK^+: mean value of plasma K^+ levels obtained in the I and II periods.
* CV: Coefficient of variation.

DISCUSSION

No significant differences were determined between the mean $C_K{}^+$ values obtained from pregnant and non-pregnant groups (Table 2; p>0.05)

Compared with non-pregnant values, mean pK^+ values were determined to be slightly lower in all trimesters but this finding was also non significant (Table 2; p>0.05).

In spite of the increased GFR in normal pregnancy (6), we observed that potassium clearance is not affected and $C_K{}^+$ values are not increased. This result was obtained despite the reverse effect of increased gestational aldosterone and DOC levels, and our finding was attributed to increased progesterone level, which acts on distal tubules to antagonize the action of aldosterone (3).

No studies about potassium clearance in normal pregnancy were available in the literature, whereas in some reports, it is concluded that gestational postural changes do not affect K^+ excretion (1-3, 8). These findings may support our results to some degree; due to increased mechanical effect of uterus during the III. trimester, the postural influence must be more apparent, and the clearance values are expected to decrease in this period (3), but in contrast to this fact, we determined the highest gestational $C_K{}^+$ levels during the III. trimester (Table 2).

In a study, plasma K^+ level was determined to decrease during pregnancy, and this finding was attributed to gestational hemodilution and increased aldosterone and DOC levels. Although we obtained similar findings, the decrement seen in gestational pK^+ levels was found to be insignificant in our study. Gestational hypokalemia may also be due to the action of increased insulin level in pregnancy, which shifts extra-cellular potassium into ICF (3-5).

REFERENCES

1. Kalousek G, Hlavacek C, Nedoss B, Pollak VE : Circadian Rhythms of Creatinine and Electrolyte Excretion in Healthy Pregnant Women. Am J Obstet Gynecol, 103:856-867, 1969.

2- Lindheimer MD, Greco F, Ehrlich EN : Postural Effects on Sodium and Steroid Excretion and Serum Renin Activity During Pregnancy. J Appl Physiol, 35:343-348, 1973.

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

4- Macdonald HN, Good W : Changes in Plasma Sodium, Potassium and Chloride Concentrations in Pregnancy and the Puerperium with Plasma and Serum Osmolality. J Obstet Gynaecol Br Commonw, 78:798-803, 1971.

5- Martin MC, Hoffman PG : The Endocrinology of Pregnancy: in Basic and Clinical Endocrinology, Ed by FS Greenspan, PH Farsham. California, Lange Med Publ, 1983.

6- Metcalfe J, Stock MK, Barron DH : Maternal Physiology During Gestation: in The Physiology of Reproduction, Ed by E Knobil, JD Neill, et al. New York, Raven Press, 1988.

7- Orten JM, Neuhaus OW : Biochemistry, 8th ed, Saint Louis, The C V Mosby Company, 1970.

8- Pritchard JA, Barnes AC, Bright RH : The Effect of the Supine Position on Renal Function in the Near-Term Pregnant Women. J Clin Invest, 34:777-781, 1955.

9- Pritchard JA, Macdonald PC : Williams Obstetrics, 15th ed, New York, Appleton-Century-Crofts Inc, 1976.

Correspondence:
Gülay LOGOGLU
Department of Physiology,
Çukurova University Medical School,
Adana, TÜRKIYE.