ESTIMATIONS OF SODIUM, POTASSIUM AND CHLORIDE IN GRAVID CONDITIONS

by

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Introduction

The osmolarity of plasma is maintained by sodium, potassium and chloride ions. Therefore, these ions are important in regulation of hydrostatic pressure. The imbalance of the levels of potassium and sodium between the intracellular and extracellular fluids leads to the edematous lesions and eventually affects the blood pressure.

The osmotic pressure of amniotic fluid is of great importance. The comparative study of these electrolytes in amniotic fluid and maternal serum has not been established. Hence, the study was undertaken to investigate the effect of pregnancy on the levels of these electrolytes to have comparative data.

Lowered serum sodium and potassium levels during pregnancy has been observed by many scientists (Harold, 1956; Savi and Torelli, 1956; Newman, 1957; Lister, 1962; Heller *et al*, 1964; Plaza Bruzual, 1965; Herbinger and Wichmann, 1967; Macdonald and Good, 1971).

Albers (1944) did not find significant difference in serum potassium of the non-pregnant and pregnant women. Harold (1956) also reported that serum potassium stayed at constant level during pregnancy. Ruck (1959) observed increasing K/Ca ratio as pregnancy advanced. Newman (1957) reported slightly decreased serum chloride in immediate postpartum period. No significant changes in chloride concentrations were observed by Savi and Torelli (1956).

Material and Methods

The subjects for this study have been selected from the Out Patient Department of Nowrosjee Wadia Maternity Hospital, Bombay 400 012. Forty-three normal gravidas in the first trimester and 34 normal gravidas in the third trimester have been studied. These subjects were examined by the resident medical officer on duty and were considered to be normal gravidas with no evident abnormalities. There was no evidence of hormonal deficiency in any of these patients. The age of these subjects varied from 18 to 40 years. In all cases studied, systolic pressure was less than 130 mm of Hg. and diastolic pressure was less than 100 mm of Hg. The 30 normal non-pregnant subjects were taken from the staff and students of the K.E.M. Hospital and Seth G.S. Medical College, Bombay with the same age group.

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Amniotic fluid was collected from 18 patients in second trimester, who were admitted to the hospital for the termination of pregnancy. These patients were absolutely normal but wanted to terminate pregnancy.

Sodium and potassium were estimated by flame photometry. Chloride was estimated by the method of Schales and Schales (1941).

Results

Mean value for serum chloride for normal non-pregnant group is 102.8 ± 4.3 mEq/L. The level increases in the first trimester and reaches to 105.3 ± 4.8 mEq/L. The level remains almost constant in second and third trimesters, the values being 105.4 ± 2.9 and 105.1 ± 3.9 mEq/L. respectively.

TABLE I

Serum, Sodium, potassium and Chloride

Parameters	Normal Non-pregnant	Trimester		
		1st	2nd	3rd
Sodium (mEq/L)	140.4 ± 11.3	142.2 ± 5.3	142.0 ± 10.9	139.3 ± 5.3
Potassium (mEq/L)	4.25 ± 0.55	4.40 ± 0.59	4.80 ± 0.69	4.38 ± 0.45
Chloride (mEq/L)	102.8 ± 4.3	105.3 ± 4.8	105.4 ± 2.9	105.1 ± 3.9

TABLE II

Sodium, Potassium and Chloride Levels of Amniotic fluid and Maternal Serum

	Sodium (mEq/L)	Potassium (mEq/L)	Chloride (mEq/L)
Amniotic fluid	137.8 ± 10.1	4.16 ± 0.31	103.4 ± 7.1
Maternal serum	141.4 ± 6.5	4.79 ± 0.57	106.2 ± 3.7

Table I represents concentrations of sodium, potassium and chloride in different groups. In normal non-pregnant group the mean value for sodium is 140.4 ± 11.3 mEq/L. The value increases slightly in first trimester 142.2 ± 5.3 mEq/L. The level remains almost constant in second trimester, the value being 142.0 ± 10.9 mEq/L. The level declines in third trimester reaching the value of 139.4 ± 5.3 mEq/L.

The mean value of serum potassium for normal non-pregnant group is 4.25 ± 0.55 mEq/L. The value increases to 4.40 ± 0.59 mEq/L in first trimester. The value continues to increase in second trimester and reaches to 4.80 ± 0.69 mEq/L. Serum potassium decreases in third trimester, the value being 4.38 ± 0.45 mEq/L.

Table II represents the levels of these electrolytes in amniotic fluid and maternal serum.

The fall in serum sodium in third trimester from that of the first trimester is significant ($p < 0.01$). The elevation of serum potassium is noted in the first and second trimesters. Both the elevations in second trimester from the first trimester and normal non-pregnant group are significant to the extent of $p < 0.001$ and $p < 0.025$ respectively. There is a decline in the third trimester from the second trimester and is significant ($p < 0..005$). The difference of levels of potassium in amniotic fluid and maternal

serum is significant to the extent of $p < 0.001$.

Discussion

It has been observed that ADH concentration is considerably higher in serum of the pregnant than of the non-pregnant women (Robinson *et al*, 1957). Estrogen levels continuously increase as pregnancy advances. It is also known to scientists that cyclic AMP level rises in maternal circulation during pregnancy (Craft *et al*, 1973). Stimulation of steroid synthesis and release by ACTH may be mediated through cyclic AMP. Cyclic AMP itself can directly duplicate ACTH action. Studies by Taylor *et al* (1939) indicated the increase in estrogen production. All these factors bring an overall retention of sodium in maternal plasma. Action of ADH causes less excretion of water from the kidneys. In order to defend the osmolarity of plasma which is 285 to 295 m Osm/litre of water, the retention of soduim had taken place. High levels of progesterone causes a loss of sodium (Landau and Lugihill, 1961). Because of the effects of the other factors like aldosterone, estrogen and cyclic AMP, the net concentrations of sodium and chloride in plasma show slight elevation in the first and second trimesters. However, in the third trimester, sodium concentration decreases which may be due to less dietary sodium and possibly more clearance of this electrolyte through kidneys.

It is understood that pregnancy is a stress condition; however, whether it is a psychological stress or a physiological stress is a matter of question. Considering it to be psychological stress, one is more prone to attribute it to nerve impulses and therefore the rise in potassium in the first and second trimesters may be explained on the exit of potassium from the axon.

It is important that osmolarity of amniotic fluid should be defended to have proper growth of the fetus since a definite pressure is maintained in the amnion. Since electrolytes help in maintaining the osmolarity, it is highly essential that the concentrations of the electrolytes should be controlled, both in maternal plasma and in amniotic fluid to avoid habitual abortions. Recent technique of terminating pregnancies by the use of distilled water by some clinicians suggests that hypoosmotic pressure of amniotic fluid can terminate pregnancy. Therefore, one may conclude that both hyper- and hypo-osmolarity may be the cause of pregnancy termination. The levels exceeding the value 152 mEq/L in both maternal plasma and amniotic fluid for sodium, 6.0 mEq/L and 4.8 mEq/L for potassium; 116 mEq/L and 112 mEq/L for chloride in maternal plasma and amniotic fluid respectively may indicate a high risk of pregnancy.

Summary

1. Comparative study of sodium, potassium and chloride has been carried out in amniotic fluid and maternal serum of the same patient.

2. The same range of levels in amniotic fluid and maternal serum has been mentioned to avoid high risk of pregnancy.

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