

EFFECT OF PREGNANCY ON CALCIUM AND CITRIC ACID LEVELS

by

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Introduction

Calcium is needed by all cells. Calcium has an important effect on nervous tissue. The nervous system becomes hyper-irritable as a result of a decrease in ionic calcium concentration in blood. This may lead to tetany consequently. A high calcium content depresses nervous irritability. Calcium is a vital element in the formation of bones and teeth. Ionized calcium is of great importance in blood coagulation, in the function of the heart, muscles and in the permeability of membranes.

Cushard *et al* (1972) reported that pregnancy is accompanied by hyperparathyroidism. Calcium and citric acid are the parameters affected by the changes in levels of PTH. It was therefore decided to estimate citric acid along with calcium in the sera of pregnant women.

The past literature indicates that hypocalcemia occurs during pregnancy (Mull and Bill, 1934; Nicholas *et al*, 1934; Mull, 1936; Bodansky and Duff, 1939; Newman, 1947; Newman, 1957; Ruck, 1959; Carvalho and Daftary, 1959; Keer *et al*, 1962;

Ahmed *et al*, 1964; Shuev, 1966; Gupta, 1968; Belceva and Matrova, 1969; Khattab and Forfar, 1970). In 1972, Tan *et al*, demonstrated that the decrease in serum calcium during pregnancy is because of the decrease in serum ionic calcium.

Material and Methods

The subject for the said study have been selected from the Out Patient Department of Nowrosjee Wadia maternity Hospital, Bombay. Forty-three normal gravidas in the first trimester, 34 normal gravidas in the second trimester and 43 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 evident 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 Seth G.S. Medical College and K.E.M. Hospital, Bombay with same age group.

Amniotic fluid was collected from 18 patients in the second trimester who were admitted to the hospital for the termination of pregnancy. These patients

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were absolutely normal but wanted to terminate pregnancy.

Calcium was determined by the method of Trinder (1960) and Citric acid was estimated by the method of Camp and Farmer (1967).

Results

± 0.503 mg%. The value increases in the first trimester reaching the peak value (10.506 ± 0.786 mg%). There is maximum depression in the second trimester, the value being 9.528 ± 0.956 mg%. The serum calcium level again increases in the third trimester reaching the value of 10.038 ± 0.475 mg%. How-

TABLE I
Serum Calcium

Group	Normal Non-pregnant	Trimester		
		1st	2nd	3rd
Number of cases	30	43	34	43
Serum Calcium (mg.%)	10.324	10.506	9.528	10.038
Standard deviation	± 0.503	± 0.786	± 0.956	± 0.475
Standard Error	± 0.092	± 0.120	± 0.164	± 0.073
Coefficient variation	4.872	7.480	10.073	4.740

TABLE II
Serum Citric Acid

Group	Normal Non-pregnant	Trimester		
		1st	2nd	3rd
Number of cases	30	43	34	43
Serum citric acid (mg.%)	2.433	3.143	3.149	2.883
Standard deviation	± 0.575	± 0.847	± 0.735	± 0.721
Standard Error	± 0.105	± 0.129	± 0.126	± 0.110
Coefficient of variation	23.880	26.950	23.340	25.008

TABLE III
Amniotic Fluid and Maternal Serum Calcium and Citric acid

		Mean (mg.%)	Standard deviation	Standard error	Coefficient of variation
Calcium	AF	6.981	± 0.920	± 0.217	13.179
	MS	9.450	± 1.138	± 0.268	12.050
Citric acid	AF	7.257	± 1.174	± 0.277	16.177
	MS	2.930	± 0.607	± 0.343	20.720

AF = Amniotic fluid. MS = Maternal serum.

Table I represents the mean values of serum calcium during different trimesters. In normal non-pregnant group the mean value for serum calcium is 10.324

ever, a generalised fall in serum calcium is observed.

Table II shows mean values of serum citric acid in different groups. The value

for normal non-pregnant group is 2.433 ± 0.575 mg%. The value increases to 3.143 ± 0.847 mg% in the first trimester. It remains almost constant in the second trimester 3.149 ± 0.735 mg%. The level declines in the third trimester and reaches to 2.883 ± 0.721 mg%. The level in third trimester is higher than the normal non-pregnant level.

Table III represents calcium and citric acid concentration in amniotic fluid and maternal serum.

Both the falls in serum calcium level in the second trimester from that of the first trimester and the normal non-pregnant group are significant to the extent of $p < 0.001$. The fall in third trimester from normal non-pregnant group is significant ($p < 0.025$). The rise observed in third trimester from second trimester is significant to the extent of $p < 0.005$. The difference of concentrations of calcium in amniotic fluid and maternal serum is significant ($p < 0.001$).

Both the elevations in serum citric acid level in the first and second trimesters are significant to the extent of $p < 0.001$. The elevation in third trimester from normal non-pregnant group is significant ($p < 0.005$). Both the depression in serum citric acid level in third trimester from the first and second trimesters are significant to the extent of $p < 0.001$. The difference of concentrations in amniotic fluid and maternal serum is significant ($p < 0.01$).

Discussion

A decline in serum calcium has been observed by many scientists during pregnancy. Considering the effect of PTH, one should expect a rise in calcium level. However, most of the scientists have observed a depression in the level for which an explanation offered is that calcium is

removed from the maternal plasma to the fetus. This removal is to meet the demand of calcium by the fetus. Newman (1947) has attributed the fall to the bone formation of the fetus. The decline is specific in 7th and 8th months of pregnancy; however, the overall effect of other factors in maintaining calcium level should be considered. The actual calcium value of plasma depends on calcium intake, the effect of PTH and the antagonistic effects of adrenal corticoids and estrogens (Nordin, 1966).

Keer *et al* (1962) have attributed the decline in calcium to hypoalbuminemia. The factor of hemodilution should also be given a due consideration.

It seems that much attention is not paid to the citrate studies in pregnant cases. Katz *et al* (1969) have reported elevated citrate levels during pregnancy.

A decline in citric acid level in the third trimester may be explained on the basis of the high energy demand by mother due to the fetus and changes in the maternal metabolism since the BMR of pregnant women increases. To compensate the energy demands the elevated citrate in plasma may be undergoing oxidation process by the citric acid cycle, thereby supplying more high energy phosphate bonds.

Summary

1. Serum total calcium has been determined in maternal serum of 1st, 2nd and 3rd trimesters and in amniotic fluid.

2. Depressed calcium level has been attributed to various factors like PTH, intake of calcium, demand of fetus and other antagonistic hormones like adrenal corticoids, estrogens. The effect of these factors determines the serum calcium level.

3. The depressed values of citric acid

levels in third trimester are attributed to the increased energy demands.

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