

"SERUM CALCIUM LEVELS IN PREGNANCY"

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Calcium, an important mineral required for many physiological processes like bone formation, cardiac action, blood coagulation and milk production, etc. is present in the body in the form of complex salts in the bone marrow (tissue stores) and in the blood in free ionized form or bound to blood proteins. During pregnancy calcium utilization in the body is enhanced to meet the requirements of the developing foetus. Depletion of the calcium stores in the body to a considerable extent results in deficiency symptoms like leg cramps, spasms, and body pains. To find if blood calcium is also utilized and to note if there is any change in serum calcium levels during pregnancy, many workers estimated the serum calcium levels at different stages of gestation. Some of the workers have reported a fall in the serum calcium levels during later months of pregnancy (Nicholas *et al*, 1934; Hardy, 1956), while others did not find any change in the serum calcium levels during pregnancy (Newman, 1953 & 1956).

Keeping in view the wide range of opinions expressed by the different workers, different calcium values of serum reported in women belonging to different countries and tracts (Carvacho, 1956; Hughes *et al*, 1929) and little work done on serum calcium estimations in North Indian

women the present study was undertaken with the following objectives:

(i) To find the serum calcium levels (total and ionized) at different stages of gestation and to note the correlation, if any, between calcium levels and length of gestation.

(ii) To note if serum calcium levels provide any index of calcium deficiency in the body as represented by deficiency symptoms, and

(iii) To find if diet or dietary calcium has any influence on the serum calcium levels.

Material and Methods

The following cases attending the gynaecology out patient department or from those admitted to the gynaecological ward of Medical College Hospital, Rohtak constituted the material for the present study.

I. 15 normal non-pregnant females.

II. 20 women in the first trimester of pregnancy (Gest. period 6-14 wks.).

III. 50 women in the second trimester of pregnancy (Gest. period 16-26 wks.).

IV. 95 women in the third trimester of pregnancy (Gest. period 28-40 wks.).

Detailed history of the cases, particularly with respect to calcium deficiency symptoms and details of diet, were recorded. None of the cases studied was getting calcium in medicinal form.

5 ml. of venous blood was collected in a clean vial and centrifuged after clot retraction. Total serum calcium was quantitatively determined by Clark and Collip's precipitation method (Oser, 1965).

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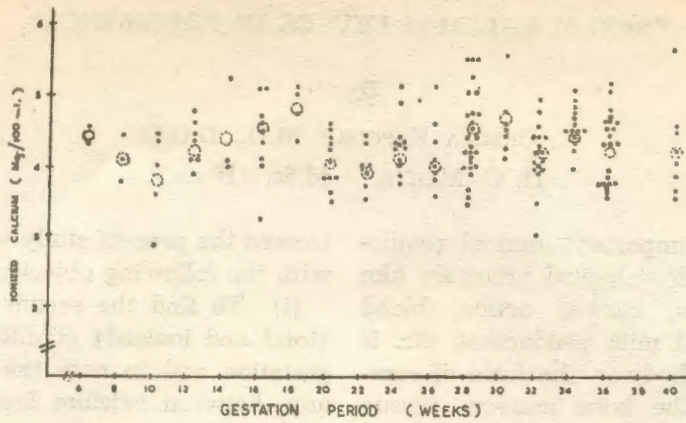


FIGURE 2. SERUM IONIZED CALCIUM LEVELS AT DIFFERENT GESTATIONAL STAGES (CIRCLES DENOTE THE MEAN VALUES)

Fig. 1

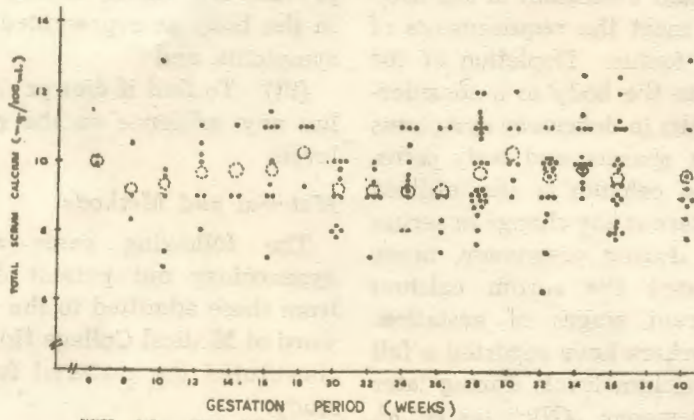


FIGURE. TOTAL SERUM CALCIUM LEVELS AT DIFFERENT STAGES OF GESTATION (CIRCLES DENOTE THE MEAN VALUES)

Fig. 2

Total serum proteins were estimated by copper sulphate specific gravity method (Oser, 1965). Ionized calcium was then interpolated from the total calcium and total proteins values by using McLean & Hastings chart (1935).

Results

Serum calcium values in normal non-pregnant females have been depicted in Table I. Total calcium values ranged between 9.0 to 13.0 mg. per 100 ml. (Average 10.08 ± 0.96 S.D.) and the ionized

TABLE I
Serum Calcium Levels in Normal Non-Pregnant Females (15 Cases)

	Range	Mean	S.D.
Serum proteins (gms./100 ml.)	6.0 - 7.3	6.8	0.39
Serum calcium (mgms./100 ml.)			
(a) Total	9.0 -13.0	10.08	0.96
(b) Ionized	3.90- 5.62	4.52	0.45

calcium values ranged between 3.9 to 5.6 mg.% (Mean 4.52 ± 0.45).

Serum calcium levels along with serum proteins values in the first, second and third trimesters of pregnancy have been presented in Table II. The values of total calcium ranged between 7.0—11.0 mg.% (Mean 9.49 ± 1.15 S.D.) during the first trimester, there was a slight decline during the second trimester (Range 7.2—11.4, Mean 9.25 ± 1.13 S.D.) and again there was an increase (Range 7.6—13.0, Mean 9.76 ± 1.05 S.D.) during the third trimester. Similarly, the values of ionized calcium were less (Range 3.23—5.10, Mean 4.18 ± 0.47 S.D.) during the second trimester than the corresponding values in the first (Range 2.80—5.25, Mean 4.27 ± 0.53 S.D.) and the third (Range 3.45—5.75, Mean 4.35 ± 0.51 S.D.) trimester. The values at all stages of pregnancy are less than the serum calcium levels in non-pregnant cases, but the differences are not significant. Serum calcium levels in primiparae, secundiparae and multiparae cases have been given in Tables III, IV and V respectively. The Tables reveal a slight decline in calcium levels with increased number of pregnancies.

Serum calcium levels in symptomatic and non-symptomatic cases have been shown in Table VI. In the symptomatic cases there is a rise in the total and ionized calcium levels with the advancement of pregnancy. On the whole, the values of total calcium are less in symptomatic cases (Range 6.3—13.0, Mean 9.26 ± 1.14 S.D.) than the respective values in non-symptomatic cases (Range 7.0—13.0, Mean 9.72 ± 1.19 S.D.). Similarly, the ionized calcium values are more (Range 2.80—5.75, Mean 4.39 ± 0.45 S.D.) in non-symptomatic cases than those in symptomatic cases (Range 2.87—5.75, Mean

TABLE II
Serum Calcium Levels During First, Second and Third Trimesters of Pregnancy (165 Cases)

Duration of pregnancy	Total serum proteins (gms./100 ml.)		Total calcium (mgms./100 ml.)		Ionized calcium (mgms./100 ml.)	
	Range	Mean \pm S.D.	Range	Mean \pm S.D.	Range	Mean \pm S.D.
1st Trimester (20 cases)	5.8-7.9	6.73 \pm 0.52	7.0-11.0	9.49 \pm 1.15	2.80-5.25	4.27 \pm 0.53
2nd Trimester (50 cases)	5.8-8.4	6.76 \pm 0.68	7.2-11.4	9.25 \pm 1.13	3.23-5.10	4.18 \pm 0.47
3rd Trimester (95 cases)	5.6-8.7	6.81 \pm 0.70	7.6-13.0	9.76 \pm 1.05	3.45-5.75	4.35 \pm 0.51

TABLE III
Serum Calcium Levels in Primiparae (49 Cases)

Duration of Pregnancy	Total serum proteins (gms./100 ml.)		Total calcium (mg./100 ml.)		Ionized calcium (mg./100 ml.)	
	Range	Mean \pm S.D.	Range	Mean \pm S.D.	Range	Mean \pm S.D.
1st trimester (7 cases)	5.8-7.3	6.63 \pm 0.54	7.4-11.0	9.61 \pm 1.28	3.57-5.25	4.36 \pm 0.48
2nd trimester (14 cases)	6.0-8.4	7.03 \pm 0.72	8.0-11.0	8.84 \pm 1.37	3.60-5.10	4.16 \pm 0.51
3rd trimester (28 cases)	5.8-7.7	6.67 \pm 0.55	7.8-12.0	9.90 \pm 1.07	3.60-5.52	4.46 \pm 0.48

TABLE IV
Serum Calcium Levels in Secundiparae (25 Cases)

Duration of Pregnancy	Total serum proteins (gms./100 ml.)		Total calcium (mg./100 ml.)		Ionized calcium (mg./100 ml.)	
	Range	Mean \pm S.D.	Range	Mean \pm S.D.	Range	Mean \pm S.D.
1st trimester (2 cases)	6.60-6.90	6.75 \pm 0.15	9.0-10.0	9.50 \pm 0.50	4.07-4.32	4.25 \pm 0.17
2nd trimester (9 cases)	5.8-8.4	6.83 \pm 0.76	7.2-11.0	9.41 \pm 1.37	3.23-5.10	4.19 \pm 0.55
3rd trimester (14 cases)	6.2-8.4	7.00 \pm 0.64	9.0-11.0	9.95 \pm 0.79	3.85-5.05	4.32 \pm 0.38

TABLE V
Serum Calcium Levels in Multiparae (91 Cases)

Duration of pregnancy	Total serum proteins (gms./100 ml.)		Total calcium (mg./100 ml.)		Ionized calcium (mg./100 ml.)	
	Range	Mean \pm S.D.	Range	Mean \pm S.D.	Range	Mean \pm S.D.
1st trimester (11 cases)	5.8-7.9	6.79 \pm 0.53	7.0-11.0	9.41 \pm 1.20	2.80-4.90	4.20 \pm 0.36
2nd trimester (27 cases)	5.8-8.0	6.59 \pm 0.63	7.2-11.4	9.40 \pm 1.10	3.75-5.10	4.18 \pm 0.43
3rd trimester (53 cases)	5.6-8.7	6.83 \pm 0.62	7.6-13.0	9.74 \pm 1.14	3.45-5.75	4.30 \pm 0.47

TABLE VI
Serum Calcium Levels (mgm./100 ml) in Symptomatic and Non-Symptomatic Cases

Duration of pregnancy	Symptomatic			Non-symptomatic		
	Number of cases	Range	Mean ± S.D.	Number of cases	Range	Mean ± S.D.
1st trimester	Total calcium	7.0 - 10.2	8.32 ± 1.29	15	7.0 - 11.0	9.88 ± 1.17
	Ionized calcium	2.87 - 4.38	3.74 ± 0.56		2.80 - 5.25	4.44 ± 0.50
2nd trimester	Total calcium	8.0 - 11.0	9.20 ± 0.99	37	7.2 - 11.4	9.30 ± 1.14
	Ionized calcium	3.85 - 5.08	4.01 ± 0.48		3.25 - 5.10	4.26 ± 0.45
3rd trimester	Total calcium	6.3 - 13.0	9.43 ± 1.28	59	7.6 - 13.0	9.95 ± 1.12
	Ionized calcium	3.00 - 5.75	4.25 ± 0.53		3.45 - 5.75	4.45 ± 0.47
Total	Total calcium	6.3 - 13.0	9.26 ± 1.14	111	7.0 - 13.0	9.72 ± 1.19
	Ionized calcium	2.87 - 5.75	4.15 ± 0.55		2.80 - 5.75	4.39 ± 0.45

4.15 ± 0.55 S.D.). The differences, however, are statistically not significant.

Serum calcium levels at different stages of gestation have been graphically depicted in figure 1 (total calcium) and figure 2 (ionized calcium). A wide scatter in the serum calcium values at all stages of gestation is noted. The value of the coefficient of correlation (r) between total calcium and length of gestation was found to be 0.11 for which 't' value is 1.16 denoting a nonsignificant correlation between these factors. The value of 'r' between ionized calcium levels and length of gestation was found to be -0.03 ('t' value 0.36), revealing that though there is a negative correlation between the ionized calcium and length of gestation, it is statistically not significant.

The effect of daily milk intake on the serum calcium levels has been shown in Table VII. The average calcium value in cases taking no milk at all is the same (9.5 ± 1.18 S.D.) as in cases taking more than 1.0 Kg. milk (9.5 ± 0.50 S.D.).

Serum calcium levels in cases with different dietary intakes (Calories) have been depicted in Table VIII. The values are less in cases taking very poor diet of caloric value below 1000 (Range 7.4-9.5, Mean 8.49 ± 0.81) than the cases taking average or good diet.

Comments

The present study revealed that serum calcium levels slightly decrease during pregnancy. This decrease is little more during the second trimester of pregnancy. This fall in serum calcium level is too low and insignificant when compared to the excessive demand of calcium for the foetal development in the mother's womb. It may be inferred that this additional calcium requirement is met from the maternal stores rather than blood. The mater-

TABLE VII
Effect of Milk Intake on Serum Calcium Levels

Daily milk intake (gms.)	Total serum calcium (mgms./100 ml.)		Number of cases
	Range	Mean \pm S.D.	
Nil	7.4-12.0	9.50 \pm 1.18	23
Less than 200	7.4-11.2	9.87 \pm 1.07	18
200 to 400	7.2-13.0	9.87 \pm 1.23	65
400 to 600	7.8-12.5	9.69 \pm 1.17	42
600 to 800	9.0-11.0	9.73 \pm 0.70	7
800 to 1000	8.0-11.0	9.74 \pm 0.96	7
More than 1000	9.0-11.0	9.50 \pm 0.50	3

TABLE VIII
Effect of Diet (Calory Intake) on Serum Calcium Levels

Daily intake (Calories)	Total serum calcium (mgms./100 ml.)		Number of cases
	Range	Mean \pm S.D.	
Less than 1000	7.4- 9.5	8.49 \pm 0.98	10
1000 to 1500	8.0-12.0	9.82 \pm 1.09	37
1500 to 2000	6.7-13.0	9.75 \pm 1.15	105
More than 2000	9.0-11.0	9.92 \pm 0.71	13

nal calcium stores, in addition to fulfilling the foetal demands, maintain the blood calcium to an almost constant level. A slight lowering of serum calcium levels was also noted with successive pregnancies (also reported by Mull & Bill, 1934). The fall, however, is very little as compared to the depletion of maternal calcium stores with successive pregnancies, which may at times result in osteomalacia in the mother.

In symptomatic cases the serum calcium levels were slightly lower than those of non-symptomatic cases. The difference, however, was not significant except during the first trimester in which the symptomatic cases had much lower calcium levels. It might be due to some temporary disturbance of calcium metabolism in the body. No evident relationship between the serum calcium levels and

calcium deficiency symptoms could be observed.

In this study it was noted that dietary supply of calcium did not affect the serum calcium levels. It might be either due to increased phosphorus intake resulting in decreased calcium absorption or the dietary calcium might contribute to the maternal calcium stores without affecting the blood calcium levels.

Though diet (Caloric intake) had little effect on serum calcium, the low values observed in cases taking very poor diet might be due to much increased catabolic activity in the body which, in one way or the other, disturbs the metabolism, absorption and regulation of calcium in the body.

Summary

Serum calcium levels in 165 cases at

different stages of gestation have been studied. There is a small and insignificant decrease in serum calcium levels during pregnancy when compared to the serum calcium values in non-pregnant cases. During pregnancy the values of serum calcium are little less during the second trimester than during the first and the third trimesters. On the whole there is no significant correlation between the serum calcium levels and length of gestation.

A slight but insignificant decline in the serum calcium levels with successive pregnancies was noted in the present study.

In symptomatic cases, the serum calcium levels are slightly lower than those of non-symptomatic cases. Although the difference is not significant, yet during the first trimester the symptomatic cases had much lower serum calcium. The serum calcium levels, however, do not provide any indication about the overall calcium deficiency in the body.

Dietary calcium had no effect on serum calcium levels. Otherwise too serum calcium levels were not affected by dietary intake, except in cases on very poor diet where lower serum calcium levels were observed.

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