

CALCIUM DEFICIENCY AND TOXAEMIA OF PREGNANCY

by

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It is well known that deficiency of calcium may lead to irritable nervous and muscular systems, even to tetanic convulsions, bleeding diathesis, capillary haemorrhages and tissue exudation apart from its effects on the bony skeleton in the form of rickets and osteomalacia. These features have got some resemblance to the clinical manifestations and pathological findings of toxæmias of pregnancy, particularly of eclampsia.

By experiments on animals it has been shown that the liver becomes vulnerable to toxins in calcium deficiency (Minot and Cutler, 1928); convulsions produced thus by carbon tetrachloride poisoning of the dogs can also be controlled by intravenous calcium injections.

The above mentioned facts make one think about a correlation between toxæmia of pregnancy and calcium deficiency, but opinions of the authorities in this regard are not uniform. While Kehrer (1920), Masaglia (1921), Theobald (1930, 1937), Mendenhall and Drake (1934) favour an etiological relationship between calcium deficiency and toxæmias of pregnancy, Dieckmann (1952), on the other hand,

does not believe in this contention.

In the present study, relationship of calcium deficiency with toxæmia of pregnancy was observed in three ways:—

- A. Estimation of serum calcium
- B. Diet survey
- C. Clinical experiment.

The details of results of the last two methods are being published elsewhere (Chaudhuri, 1968a, 1968b). Only those portions which are connected with the study of calcium deficiency in toxæmia of pregnancy will be narrated and discussed in this paper.

Material and Method

Cases for estimation of serum calcium were selected at random from R. G. Kar Medical College Hospital, Calcutta. Twenty-five cases of non-toxæmic pregnancy over 32 weeks' gestation were selected from the antenatal clinic which were used as controls. Thirty-five cases of severe pre-eclampsia and 21 cases of eclampsia were selected from those admitted under the author.

The blood samples of control cases were obtained from patients attending the clinic and those from toxæmic cases were collected within 48 hours of admission. The samples were drawn before the mid-day meal and care was taken to see that there was no venous stasis during collection.

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About 10 ml. of blood was withdrawn by venipuncture and allowed to flow gently into a clean dry test tube which was kept at room temperature until the serum separated. The specimen was then sent to the laboratory of the All India Institute of Hygiene and Public Health, Calcutta. The serum was poured into centrifuge tubes and centrifuged. The estimation was done on the same day.

The estimation of serum calcium was done by Oxalate-Permanganate procedure (Clerk and Collip, 1926, as quoted by King and Wootton, 1956).

Results

The results of estimation of total serum calcium are shown in Table 1.

TABLE I

Serum calcium levels in toxæmic and non-toxæmic pregnancy cases

| Subjects | No. of cases | Serum calcium (mg. per 100 ml.) | |
|--------------------------|--------------|---------------------------------|---------------|
| | | Mean + S.D. | Range |
| (a) Control | 25 | 8.64 + 0.77 | 7.40 to 10.00 |
| (b) Severe pre-eclampsia | 35 | 7.92 + 0.55 | 7.08 to 8.96 |
| (c) Eclampsia | 21 | 7.97 + 0.50 | 7.38 to 9.00 |

Table 1 shows that in severe pre-eclampsia the serum calcium was reduced to 7.92 mg. per cent as compared to that of the non-toxæmic pregnancy cases (8.64 mg. per cent). The difference was highly significant ($t=4.24$). In eclampsia cases, too, there was a drop in serum calcium, the average figure being 7.97 gm. per cent. The difference of this level with that of the control cases was highly significant too ($t=-3.41$).

Discussion and conclusion

It was found that the serum calcium levels were significantly lower in both severe pre-eclampsia and eclampsia cases as compared to that of the non-toxæmic pregnancy control cases (Table 1). However, the serum calcium level could not be correlated with the severity of toxæmia. This suggests an association between calcium deficiency and toxæmia of pregnancy. This contention is amply supported by the results of two other studies in this connection. Firstly, diet survey was conducted amongst 90 non-toxæmic pregnancy cases in the later months and 85 pre-eclampsia cases. The daily calcium intake of the non-toxæmic cases was found to range between 0.21 to 1.8 gm. with an

average figure of 0.40 gm. as against 0.15 to 1.1 gm. of calcium with an average of 0.30 gm. consumed by the toxæmic group. It may be noted that the calcium intake by the non-toxæmic control cases is also much less than is recommended (1.5 gm. daily). It is mainly due to lack of milk in the diet. Over and above that, a great part of this calcium comes from cereals which are rich in phytic acid which hinders calcium absorption. Indian women parti-

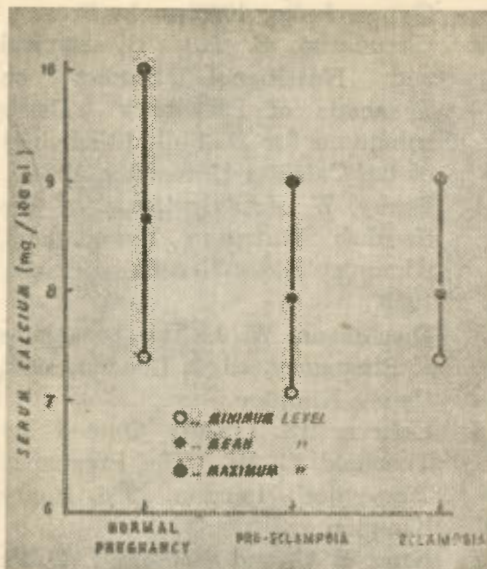


Fig. 1

Serum calcium levels in non-toxaemic and toxaemic cases of pregnancy.

cularly of the lower class are habituated to take betel leaves with lime (calcium hydroxide) which partly compensates for the deficiency of calcium in the diet. It was further observed that the calcium intake was much more in the higher socio-economic group amongst whom the incidence of toxaemia was also less, as compared to those in the lower income class (Chaudhuri, 1968c). Less intake of calcium by the toxaemic group is also reported by McNaughton from Australia. Manson Bahr (1951) reported that the incidence of eclampsia was much less amongst the Fijian women than amongst the Indians in Fiji Island. Diet survey showed that the Fijian women consumed twelve times as much of calcium and four times as much of iron than the Indian women.

Secondly, clinical experiment was

conducted by noting the effect of nutrient supplement on the incidence of toxaemia. Five hundred cases within 24 weeks of pregnancy were supplied with vitamin-mineral pills containing calcium gluconate, 3 gm. and calcium phosphate 0.25 gm., together with iron and all the important vitamins. The incidence of toxaemia in this group was compared with that of the control cases, 200 in number, who had the same antenatal care but without any nutrient supplement. The incidence of toxaemia was significantly reduced to 4.8 per cent in the former group as compared to 14.6 per cent in the latter group. It is reasonable to infer from this experiment that calcium supplement is partly responsible for this remarkable result. This study confirms to some extent the results obtained by Mendenhall and Drake (1934) and Theobald (1937) who showed separately significant reduction in the incidence of toxaemia by supplementing diets of different groups of cases with calcium, with or without vitamin D.

Calcium metabolism is under strain during pregnancy. That is why osteomalacia is particularly prone to manifest itself during this time. Expectant mothers need to store about 30 to 50 gm. of calcium during the course of pregnancy, of which 23 gm. are needed by the foetus. The foetal demand is 0.3 gm. per day in the last trimester of pregnancy (Wohl and Good Hart, 1955). Apart from the foetal demand, the mother needs calcium for the formation of placenta and for the growth of maternal tissues.

Against this extra demand is to be offset the great power of adaptation

of human beings to nutritional deficiency (Steggerda and Mitchell, 1941; Swanson, 1951; Darby, 1963). It is thought that when this power of adaptation fails toxaemic features appear in some pregnant women.

From the above study, though calcium deficiency cannot be pinpointed as the sole factor for the etiology of toxaemia, its relationship with toxaemia cannot be denied. It is postulated that calcium deficiency is a predisposing factor in the causation of toxaemia and may be playing a part in producing eclamptic convulsions.

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