A STUDY OF THIAMINE IN SERUM AND CORD BLOOD IN TOXEMIA OF PREGNANCY

by

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Toxemia of pregnancy remains the enigma of obstetrics and contributes one of the most important unsolved problems in the field of human reproduction. It is referred to as the disease of theories. Several workers have considered toxemia as a result of multiple nutritional deficiency in which thiamine plays a dominant role. The role of thiamine deficiency and its clinical significance has been subject to research since 1928. Chaudhuri (1969) postulated the possible role of thiamine deficiency as one of the predisposing factor in the etiology of toxemia. Thiamine is concerned with intermediate carbohydrate metabolism and its deficiency leads to accumulation of acid metabolites in the tissues. The normal blood pyruvic acid level varies between 0.5 mg to 1.0 mg per 100 ml. and it increases upto 2 mg to 3 mg per 100 ml in thiamine deficiency.

The foetus derives its supply of vitamins from the mother; the water soluble vitamins are present in the foetal blood at higher concentration than maternal blood. These water soluble vitamins are essential co-factors for numerous enzymes. Sloboddy *et al* (1949) have given ratio of relative concentration of thiamine in cord and blood and maternal blood as 1:8.

The present study aims to evaluate pyruvic acid levels in healthy normal non-pregnant women, in normal pregnant women after 28 weeks of pregnancy and in patients of toxemia of pregnancy with a bias to nutritional etiology.

Material and Methods

The subjects for the present study were selected from the out-patient and in-patient department of the Govt. Hospital for Women, Amritsar and were grouped as follows:

Group I. Twenty healthy normal and non-pregnant women in child bearing age were selected at randon to evaluate the thiamine nutritional status in this part of the country.

Group II. Forty normal healthy pregnant women after 28 weeks of pregnancy were studied as control cases.

Group III. Twenty cases of mild pre-eclampsia.

Group IV. Twenty cases of severe pre-eclampsia.

Group V. Ten cases of eclampsia.

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Group VI. Ten patients of normal pregnancy during normal labour for simultaneous collection of samples of:

(a) maternal blood and

(b) cord blood;

Group VII. Ten cases of toxemia of pregnancy during delivery for simultaneous collection of samples of:

(c) maternal blood and

(d) cord blood;

In all these groups the detailed socio-economic, obstetric, menstrual and dietetic history was recorded. The patients receiving vitamins B-complex therapy were excluded from the study. Detailed general physical and systematic examinations were also done. Cases associated with disease of thyroid and any fever were excluded from study.

Collection of blood samples

Maternal Blood: Maternal venous blood was withdrawn from the fasting patients with a dry heparinised syringe, carefully eliminating tourniquet stasis. 3 ml of blood sample was then rapidly ejected into 12 ml of cold solution of 10% trichloracetic acid in a stoppered test tube and the supernatant was utilized for the estimation of pyruvate by method of Friedemann and Haugen (1943).

The blood samples in case of eclampsia patients were collected before starting the glucose drip.

Cord Blood: The samples for cord blood investigation were taken at the time of vaginal delivery. Control cases selected for cord blood samples were those not more than 24 hours in labour. Cases with foetal distress were excluded from the study.

Results and Discussion

The present study was carried out on 20 normal non-pregnant women in child bearing age to evaluate the status of thiamine without the stress of pregnancy, so representing the population from which normal pregnant women and patients of toxemia of pregnancy were compared. In order to understand the relationship of thiamine deficiency pyruvate estimations have been done in various groups. The data collected were analysed statistically and are discussed in the following groups:

Group I

Normal Non-pregnant Women: Stark and Schlund (1963) estimated pyruvic acid in healthy non-pregnant women and recorded a mean value of 0.58 mg%.

In the present study the pyruvate level in non-pregnant women had mean value of 0.737 ± 0.113 mg%.

Group II

Normal Pregnant Women: Soiva *et al* (1962) in a study of 26 women during the last 3 months of normal pregnancy have reported the average blood pyruvic acid concentration of 1.145 ± 0.194 mg% while Chaudhuri *et al* (1969) in a study reported the values of blood pyruvic acid levels between 0.5% to 1.0 mg%. Of the 40 normal pregnant cases, in our study, 20 were primigravidae and 20 were multiparae. The pyruvate level was 0.96 ± 0.189 mg% in cases of multipara and 0.70 ± 0.103 mg% in primigravidae.

Group III

Mild Pre-eclampsia: Soiva *et al* (1962) reported pyruvate concentration of 1.527 ± 0.589 mg%.

In the present study of mild pre-eclampsia the pyruvate levels obtained were 1.10 ± 0.283 mg%.

Group IV

Severe Pre-eclampsia: Pyruvic acid concentration of 1.444 ± 0.502 mg% has

been observed by Sovia *et al* (1962) while Chaudhuri *et al* (1969) reported an increase in pyruvic acid concentration to 0.86 ± 0.26 mg%. We obtained an increase in pyruvate concentration to 1.72 ± 0.416 mg%.

Group V

Eclampsia: Chaudhuri *et al* (1969) have reported the pyruvic acid concentration as 1.05 ± 0.24 mg%. In the present study we obtained an increase in the pyruvate values which were as 2.15 ± 0.537 mg%.

Group VI

During Normal Labour: Castello *et al* (1968) reported on the difference in concentration in maternal and cord blood. Low *et al* (1974) in a study have reported the pyruvate values in maternal venous blood at the time of delivery as 1.56 ± 0.57 mg% and have also reported the pyruvate concentration in umbilical vein and artery blood during delivery as 1.2 ± 0.36 mg% and 1.3 ± 3.35 mg% respectively.

In the present study in the group with normal duration of labour, the pyruvate values in the maternal venous blood was 2.99 ± 0.53 mg% and in cord blood the values were 1.73 ± 0.28 mg%.

Group VII

Maternal Venous Blood and Cord Blood in Toxemia of Pregnancy During Labour:

In our study during labour in toxemia pregnancy the pyruvate values in the maternal venous blood were 3.9 ± 0.97 mg%. The pyruvate in cord blood had values 2.18 ± 0.58 mg.%

On statistical analysis it was found that pyruvate values in normal non-pregnant, when compared to the normal pregnant values were significant at 5% level.

The values of pyruvate in multiparae when compared with primigravidae were found to be significant at 1% level.

The pyruvate values in mild pre-eclampsia compared with normal pregnant women have been found statistically significant at 1% level. In light of the metabolic pathways, the raised pyruvate values in mild pre-eclampsia suggests thiamine deficiency. The values of pyruvate level in severe pre-eclampsia and eclampsia when compared with normal pregnant women have also been found to be significant at 1% level in both cases. A positive co-relation ($r = 0.6428$) has been found between blood pressure and pyruvate of eclampsia group only. This showed that with the increasing severity of the disease there is an increase in the pyruvate level.

The above results suggest an association between thiamine deficiency and toxemia, particularly severe pre-eclampsia and eclampsia. Pyruvic acid levels are also raised in deficiency of panthothenic acid, biotin and in diabetes mellitus, congestive heart failure, digestive disturbances and liver damage (Kleeberg and Gibson, 1954). Lesions of the liver have long been recognised as fairly common in fatal cases of pregnancy toxemia. It is also known that endocrine imbalance is of primary importance in the genesis of the clinical picture. It is possible that the hormone inactivation function of liver may be easily affected by dietary changes which result in a metabolic shift. Investigations by several workers showed that amongst the B-complex vitamins, only thiamine and riboflavin are necessary for hepatic inactivation of oestrogen (Gyorgi and Goldblatt, 1945).

The significant association between thiamine deficiency and toxemia have been supported by the results carried out

by Chaudhuri (1969. It is concluded that thiamine deficiency is not the sole cause of toxemia. However, its role in this disease cannot be denied.

On statistical analysis it was found that pyruvate values in cord blood of normal pregnant women when compared with pyruvate levels in cord blood of toxemia patients were found significant at 5% level. The increased pyruvate values in the cord blood of toxemic patients may be correlated with the sluggish placental transfer function.

Pyruvate values in maternal venous blood of the normal pregnant women when compared with maternal venous blood of toxemic patients during labour were found to be statistically significant at 5% level. The raised value of pyruvate in maternal blood during labour in toxemic patients suggests an association between thiamine deficiency and toxemia.

The pyruvate concentration of the maternal venous blood was shown to be considerably higher than that of cord blood suggesting the important concept that the foetus takes its supply of thiamine from the mother. Slobody *et al* (1949) showed that the mean thiamine value for cord blood was almost twice than that for maternal blood. Thiamine is coenzyme that takes part in the oxidative enzyme systems which are required in cellular respiration. During foetal life, due to relatively low oxygen tension, larger amounts of vitamins are required. The increased need is met actively at the expense of maternal nutrients. The placenta herein selectively transfers the required metabolites in adequate amount. After the foetus is delivered there is relatively high oxygen tension and so it is equipped with supply for optimal function.

Summary

Deficiency of thiamine does have a role to play in the toxemia of pregnancy. Blood pyruvate has been taken as the index parameter of evaluation of the deficiency. Its levels in non-pregnant normal pregnancy and various grades of toxemia and eclampsia and also in the maternal and cord bloods during normal and toxemia pregnancy and labour, positively support the hypothesis, implicating thiamine deficiency as at least a predisposing factor. But the exact site of metabolic lesion is not revealed.

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