MATERNAL SERUM ALKALINE PHOSPHATASE IN RELATION TO FOETAL MATURITY

by

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Assessment of foetal maturity and placental function is of known clinical importance in obstetrical practice, particularly in conditions like diabetes mellitus, erythroblastosis foetalis and toxaemia of pregnancy where early termination of pregnancy is desired. Further, in a country like ours where the women are mostly illiterate and are not sure about their duration of pregnancy, assessment of foetal maturity presents obvious difficulties. Besides, one has also to consider the placental function which may differ in different patients at the same period of gestation due to certain placental defects resulting in placental insufficiency. Estimations of maternal heat-stable serum alkaline phosphatase has proved to be an answer to this problem as it indicates foetal maturity and at the same time throws some light on the placental function (Levine and Wood, 1965).

Increase in the level of maternal serum alkaline phosphatase in late pregnancy was first observed by Coryn in 1934. This has since been confirmed by various workers (Meranze *et al,* 1937; Young *et al,* 1946; Beck and Clark, 1950; Friedman and Lapan, 1961; Zuckerman *et al,* 1965). However, the total amount of alkaline phosphatase found in the maternal serum is not entirely of placental origin and several other tissues like liver, bones and intestines contribute to it (Boyer, 1963; Meade and Rosalski, 1963). Several methods have been tried to distinguish the serum alkaline phosphatase of placental origin from that of other sources. McMaster *et al* (1964) and Neale *et al* (1965) described a simple method to differentiate between human serum alkaline phosphatase of placental and non-placental origins. These authors reported that the level of "heat stable" alkaline phosphatase which is entirely of placental origin rises progressively with advancement of pregnancy, while the non-placental alkaline phosphatase which remains within normal limits is destroyed by heating the maternal serum at 56°C for 30 minutes and is labelled as "heat labile" alkaline phosphatase.

Here we report our observations on maternal serum alkaline phosphatase

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levels with special reference to its heat stable fraction in relation to foetal maturity.

Material and Methods

A total of one hundred normal pregnant women were examined for their serum alkaline phosphatase during different trimesters of pregnancy from Upper India Sugar Exchange Maternity Hospital, Kanpur, and from our consulting practice. Twenty-five non-pregnant normal women of the same age group were taken as controls.

The cases were divided into the following four groups.

Group I: Twenty-five normal non-pregnant women between the ages of 20-40 years.

Group II: Twenty-five normal women in the first trimester of pregnancy.

Group III: Twenty-five normal women in the second trimester of pregnancy.

Group IV: Fifty normal women in the third trimester of pregnancy. In this gronp blood samples were taken at different weeks of pregnancy from the same patient to exclude the error due to individual variation. Thus a total of 200 blood samples were collected.

Five millilitres of venous blood were taken which was allowed to clot for one hour. The clotted blood was centrifuged for 10 minutes at 3000 r.p.m. Each serum sample was divid- into two equal parts. One part was heated at 56°C for 30 minutes in a water bath to destroy the "heat labile" component of the serum alka- line phosphatase, while the other sample was kept at room tempera- ture. Serum alkaline phosphatase estimation of both the samples was done on the same day. The method used was the same as described by McMaster *et al* (1964). The values of "heat labile" alkaline phosphatase were obtained by substracting "heat stable" from total alkaline phos- phatase. The results have been ex- pressed in King and Armstrong (1934) units per 100 ml.

Observations

It is evident from Table I that there is no significant difference in the levels of either total or heat stable alkaline phoshatase in the non-preg- nant and the pregnant women in the first and second trimesters. In the third trimester, the mean total serum alkaline phosphatase activity rose to 12.83 K.A. units per 100 ml. This increase was entirely due to the heat

TABLE I

Mean values along with standard deviation (in K.A. units per 100 ml) of different fractions of serum alkaline phosphatase in various groups

Groups	No. of cases	No. of blood samples taken	Serum Alkaline Phosphatase		
			Total	Heat Stable	Heat Lablile
I	25	25	7.98±1.17	0.70±0.10	7.28 ±0.83
II	25	25	8.08±0.73	0.744±0.08	7.336±0.22
III	25	25	8.43±0.66	0.724±0.08	7.708±0.62
IV	50	200	12.83±2.50	5.03±2.30	7.80 ± 0.19

TABLE II

Mean values along with standard deviation (in K.A. units per 100 ml) of different fractions of serum alkaline phosphatase in different weeks of third trimester of pregnancy

Week of Gestation	No. of blood samples taken	Serum Alkaline Phosphatese		
		Total	Heat Stable	Heat Labile
28	10	8.64 ± 0.78	0.79 ± 0.14	7.85 ± 0.601
29	10	9.24 ± 0.63	1.22 ± 0.20	8.02 ± 0.45
30	10	9.32 ± 0.63	1.36 ± 0.18	7.96 ± 0.49
31	15	9.41 ± 0.55	1.54 ± 0.27	7.87 ± 0.46
32	20	10.34 ± 0.53	2.45 ± 0.25	7.89 ± 0.39
33	15	12.15 ± 0.71	4.47 ± 0.404	7.68 ± 0.62
34	20	12.65 ± 0.64	4.88 ± 0.27	7.77 ± 0.57
35	20	12.77 ± 0.42	4.99 ± 0.27	7.78 ± 0.29
36	25	14.41 ± 0.43	6.54 ± 0.32	7.87 ± 0.304
37	20	14.84 ± 0.38	7.00 ± 0.42	7.84 ± 0.35
38	15	14.98 ± 0.51	7.21 ± 0.506	7.77 ± 0.27
39	10	15.33 ± 0.50	7.55 ± 0.30	7.78 ± 0.17
40	5	15.22 ± 0.74	7.52 ± 0.59	7.70 ± 0.53
41	2	15.60 ± 0.80	8.00 ± 0.60	7.60 ± 0.20
42	1	15.30 ± 0.00	7.50 ± 0.00	7.80 ± 0.00
43	2	15.00 ± 0.20	7.35 ± 0.80	7.65 ± 0.07

stable alkaline phosphatase fraction.

Table II and Figure I show that there is a progressive rise in the total serum alkaline phosphatase in the third trimester of pregnancy. Since the values of heat labile alkaline phosphatase level remained constant it can be inferred that the rise in the total serum alkaline phoshatase level was due to elevation of heat stable component. A progressive rise in the level of heat stable alkaline phosphatase was observed during the third trimester of pregnancy, with a peak at 41st week of gestation. The values of heat stable alkaline phosphatase approached approximately fifty per cent of the total alkaline phosphatase after 37 weeks of pregnancy.

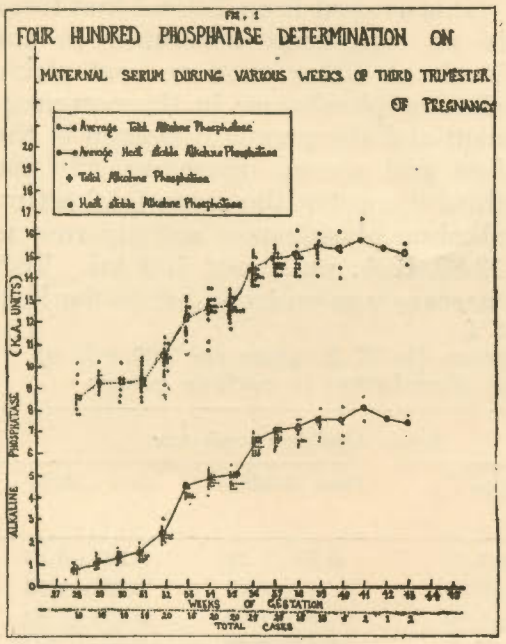

Fig. 1

Discussion

Our values of 7.98 ± 1.17, 0.70 ± 0.10 and 7.28 + 0.83 K.A. units per 100 ml. for total, heat stable and heat labile serum alkaline phoshatase respectively in normal non-pregnant women are in close agreement with those of other Indian workers (Peters and Parihar, 1968). In the first and

second trimesters of pregnancy no significant rise in the levels of either total or heat stable alkaline phosphatase was observed by us as compared to the non-pregnant women; while in the third trimester the mean total serum alkaline phosphatase activity rose to 12.83 K.A. units per 100 ml. This raised activity was due to significant ($P < 0.05$) increased levels of the mean heat stable alkaline phosphatase which rose from 0.724 ± 0.08 K.A. units per 100 ml in the second trimester to 5.03 ± 2.30 K.A. units per 100 ml. in the third trimester. There was, however, no significant change in the levels of mean heat labile alkaline phosphatase in the second and third trimesters of pregnancy. Similar observations were made by McMaster *et al,* 1964, Levine and Wood, 1965, Levine *et al,* 1966 and Peters and Parihar 1968.

In our series, pregnant women having a total serum alkaline phosphatase level of 14 K.A. units per 100 ml. or more, of which about 50 per cent was "heat stable", delivered a viable child. This also incidentally correlates with a gestational period of 36 weeks or more. Our findings are in agreement with those of Levine *et al,* 1966. Values below this may be taken as either due to prematurity of the foetus or placental insufficiency.

Summary

1. Levels of total, heat stable and heat labile serum alkaline phosphatase were determined in 25 normal non-pregnant women and 100 normal pregnant women.

2. There was no significant difference between the values of total, heat stable and heat labile alkaline phosphatase levels in the non-pregnant women and pregnant women in the first and second trimester.

3. There was a gradual increase in the level of heat stable alkaline phosphatase in the third trimester of pregnancy from 28th week to 41st week after which there was a fall in its values, while the heat labile alkaline phosphatase remained more or less within normal limits.

4. Pregnant women having a mean value of 14.0 K.A. units per 100 ml. for total serum alkaline phosphatase, of which about fifty per cent was the heat stable fraction, delivered a viable child.

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