OBSERVATIONS ON THE ALKALINE PHOSPHATASE ISOENZYME DISTRIBUTION IN MATERNAL AND AMNIOTIC FLUID COMPARTMENTS IN NIGERIAN PARTURIENTS

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Summary: Estimation of the alkaline phosphates isoenzymes in paired maternal serum and amniotic fluids in term uncomplicated pregnancies and in patients with pre-eclampsia, showed poor correlation coefficients between the levels of both heat stable and heat labile isoenzymes. There was a statistically significant fall in AF ($P < .05$) HSAP in pre-eclampsia and a highly significant rise of HLAP in meconial liquor.

It is concluded that the poor correlation between the levels of HSAP in maternal serum and amniotic fluid (despite their common source of origin), the normal levels of HLAP in maternal serum in the presence of significantly high levels of HSAP in maternal serum in the presence of significantly diminished levels in amniotic fluid point to a state of relatively diminished permeability of the chorioamniotic membranes to the alkaline phosphatase isoenzymes in Nigerians.

INTRODUCTION

The locus of expression of the heat stable alkaline phosphatase isoenzyme in the placenta is exhibited by three main genotypic allees (PI^S, PI^F, PI^I) with varying enzymatic activity. The demonstration in Nigerians ([1]) of a significantly low incidence of the PL^F allee (associated with the highest enzymatic activity) implies therefore that there may be population variations in the production of this isoenzymes especially in conditions like pre-eclampsia where a racial variation in the clinical course has been emphasized by several Authors ([2]).

This paper therefore reports on the levels and comparative distribution of the alkaline phosphatase isoenzymes in maternal serum and amniotic fluid compartments in normal and complicated pregnancies in Nigerian parturients.

MATERIAL AND METHODS

The subjects were 72 patients admitted in established labour to the obstetric unit of the University of Benin Teaching Hospital. They all had singleton pregnancies between 37-42 weeks gestation. None had any chronic medical disorders like essential hypertension or diabetes. Fifty-one had uncomplicated pregnancies while the others (21) had pre-eclamptic toxaemia defined as an elevation (over the booking blood pressure observed at <20 weeks gestation of 30 mmHg and 20 mmHg in the diastolic and systolic pressures respectively obtained on two occasions 12 hours apart with or without oedema or proteinuria.

Amniotic fluid was obtained during artificial rupture of the membranes followed by maternal venepuncture. Blood was allowed to stand for 15 minutes and sera extracted. Obviously blood stained liquor was discarded and the paired serum and amniotic fluid samples stored at −20 °C until batch measurement.

Heat stable and heat labile alkaline phosphatase in serum and amniotic fluid samples were measured by the method of Teaford and White as previously described ([3, 4]).

One unit (U) of activity is the amount of enzyme that liberates one micromole of p-nitrophenol from disodium p-nitrophenol phosphate at 37 °C after 15 minutes incubation at pH 9.8. Each unit is expressed in mcromole of p-nitrophenol phosphate per litre (nmol/L).

RESULTS

There were no differences in the levels of HSAP and HLAP isoenzymes in maternal serum and amniotic fluid compartments. Significant was the poor conrelation co-efficient of HSAF ($r = .18$)

Table 1. – *Alkaline phosphatase isoenzymes in amniotic fluid (AF) and maternal serum (S) in normal pregnancies complicated by toxaemia.*

	Normal Pregnancy (n = 51)	Toxaemia (n = 21)	Comments
HSAP in AF	*324.0±302.4	**151.2±45.4	t = 2.4, P < .05 (Significant)
HSAP in MS	280.8±158.4	**321.8±280.8	t = .03, P < .50
HLAP in MS	177.8±57.6	172.8±54	t = .1, P < .50

* t < .59; r = < .15; P < .5 (not significant)
** t = 2.8, P < .01 (significant)

and HLAP (r = .15) in maternal serum and amniotic fluid (table 1). Six patients with apparently uncomplicated pregnancies had amniotic fluid levels of HSAP > 1000 U/L (±2 SD) but had normal levels in maternal serum. Although there was a significant difference (P<.05) in amniotic fluid levels of HSAP between uncomplicated pregnancies (324.0±302.4 U/L) and in patients with pre-eclampsia (151.2 ± 45.4) there were no significant differences in their corresponding maternal serum levels (t = .03, p>.50).

In the consideration of the effect of meconium on the levels of these isoenzymes, table 2 shows a highly significant difference (T = 24.3, P < .001) between the levels of HLAP in meconial liquor (mean 835.2 ± 230.4) and clear liquor (mean 206.6 ± 116.6). Again, there was no difference between the levels of HLAP in maternal serum in patients with clear and meconial liquor. Finally meconial liquor had no obvious effect on the levels of HSAP either in maternal serum or amniotic fluid.

DISCUSSION

Since serum levels of HLAP isoenzyme during pregnancy is wholly maternal in origin with no fetal or placental contribution (there is in fact a significant fall of this enzyme in the 2nd and 3rd trimesters of pregnancy [4]) and a significant amount of the HLAP found in term amniotic fluid is fetal in origin [5]), the lack of correlation of the levels of this isoenzyme in the two compartments was perhaps to be expected. However, it is difficult to explain easily our observations concerning the HSAP in both maternal serum and amniotic fluid – the activity of which is placental – entirely localized to the external surface of the syncytial villi in close relationship with the maternal circulation. One would therefore have expected, as Roopnarinesign *et al.* [6]) found, not only higher levels of this enzyme in maternal serum but also a significant correlation co-efficient between their levels.

Although our observation on the normal maternal serum levels of HSAP in pre-

Table 2. – *Alkaline phosphatase isoenzymes in patients with clear and meconial liquor.*

	Clear Liquor (n = 52)	Meconial Liquor (n = 20)	Comments
HSAP in AF	314.5±252.2	252.2±187.4	t = .7, P < .50
HSAP in MS	309±150.4	288±72.0	t = .5, P < .50
HLAP in MS	200.1±115.2	165.6±51.2	t = 1.4, P < .20
HLAP in AF	201.6±116.6	835.2±230.4	t = 24.3, P < .001 (Highly significant)

eclampsia are in agreement with reports by Beckman (1978), they disagreed with the findings by Segan *et al.* ([5]) who found increased levels of this isoenzyme. The significantly low levels of amniotic fluid HSAP in pre-eclampsia is also at variance with previous reports that had indicated either unelevated([7]) or increased values([8]). Two factors may be responsible for these observations. It is likely that the acute or fulminating nature of pre-eclamptic toxaemic (PET) in Nigerians which has been emphasized by several authors ([12]) may have little long term effect on placental function. Secondly, as indicated in the introduction, there are racial variations in allele distribution. For example, the PL^F allele with the highest enzyme activity is 14 times less common in Nigerians compared to Caucasians in New Haven ([1]). Since the symptomatology of PET in Nigeria also implies a racial variation it is possible there is a selective influence by PET on the placental secretion of HSAP. To lend credence to the above is the observation by Adeniyi *et al.* ([9]) reporting also from Nigeria who found significantly diminished levels of alkaline phosphatase in placentae from pre-eclamptic pregnancies whilst Curzens *et al.* ([10]) in their histochemical studies on placental alkaline phosphatase in Caucasians found increased amounts of this enzyme.

Our work has also identified as previously reported ([8, 11]) high levels of HLAP in meconial liquor. Specifically, estimation of amniotic fluid HLAP was 94% (68/72) accurate in discriminating clear from meconial liquor as 49/52 patients with clear liquor and 1/20 (5%) with meconial liquor had values below 300 U/L. The normal maternal levels of HLAP in the presence of meconial liquor does not, however, agree with the findings of Thaler *et al.* ([11]), who had advocated routine estimation of maternal serum HLAP as a reliable non-invasive test to identify meconial liquor.

Since it seems certain that the major routes of transfer of these isoenzymes between the two compartments are the chorioamniotic membranes (HSAP is not identifiable in the umbilical cord ([9])), several observations in our study point to a state of relatively diminished permeability of these membranes to the alkaline phosphatase isoenzymes in Nigerians. These include the poor correlation between the levels of HSAP in maternal serum and amniotic fluid; the normal levels of HLAP in maternal serum in the presence of significantly high levels in meconial liquor and the normal levels of HSAP in maternal serum in pre-eclampsia with significantly diminished levels in amniotic fluid.

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