

Relationship between placental alkaline phosphatase activity and cord blood glucose, albumin and neonatal birth weight at term.

Innocent Onyesom¹, Adefunke Olukemi Opajobi¹, Ugochukwu Enyinanya Uzuegbu¹, Denis Oriero¹, Joseph Mordi¹, Prosper Ejiro Awehin¹ and Enaholo Timothy².

¹Department of Medical Biochemistry, Delta State University, Abraka, Nigeria and

²Zumax (Nig) Ltd., Shell Ogunu Yard, Warri, Nigeria.

Key words: Placental alkaline phosphatase, cord blood, glucose, neonate, pregnancy.

Abstract. It has been observed that placental alkaline phosphatase (PAP) activity progressively rises as pregnancy advances, possibly, because of its increasing synthesis by placental tissue. The present investigation therefore, examines the relationship between placental alkaline phosphatase activity and the biochemical indices of foetal nutrition (cord blood glucose, albumin) and growth (neonatal birth weight). Placental and umbilical cord blood samples were collected from one hundred and five deliveries and prepared for both, placental alkaline phosphatase assay, and glucose and albumin estimations using standard procedures. The birth weights of the neonates at term were taken and recorded. Correlation analyses of the data obtained show significant positive relationships between PAP and cord blood glucose ($r^2 = 0.86$, $p < 0.05$), albumin ($r^2 = 0.71$, $p < 0.05$) and birth weight ($r^2 = 0.68$, $p < 0.05$), but no significant relationship with gestational age. PAP may be essential in nutrient mobilization to the foetus. However, further studies involving more subjects and an intrauterine growth retardation control group (IUGR) are required to fully document the present report.

Relación entre la actividad de la fosfatasa alcalina placentaria, glucosa y albúmina en sangre del cordón umbilical y el peso en recién nacidos a término.

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Palabras clave: Fosfatasa alcalina placentaria, cordón umbilical, glucosa, neonato, embarazo.

Resumen. Se ha observado que la actividad de la fosfatasa alcalina placentaria (PAP) aumenta progresivamente a medida que avanza el embarazo, posiblemente debido al incremento de su síntesis a través del tejido placentario. Por lo tanto, la presente investigación estudia la relación entre la actividad de la fosfatasa alcalina placentaria y los índices bioquímicos de la nutrición fetal (glucosa sanguínea de cordón umbilical, albúmina) y crecimiento (peso neonatal). Se recolectaron muestras placentarias y sanguíneas provenientes de 105 partos y preparadas tanto para el ensayo de fosfatasa alcalina placentaria como para estimaciones de glucosa y albúmina utilizando los procedimientos estándar. Se tomaron y registraron los pesos de los recién nacidos a término. El análisis y la correlación de los datos obtenidos muestran una relación significativamente positiva entre el PAP y la glucosa en sangre del cordón umbilical ($r^2 = 0,86$, $P < 0,05$), albúmina ($r^2 = 0,71$, $P < 0,05$) y peso al nacer ($r^2 = 0,68$, $P < 0,05$), pero no relación significativa con la edad gestacional. PAP puede ser esencial en la movilización de nutrientes para el feto. Sin embargo, se requieren estudios posteriores que incluyan más sujetos y un grupo control con retardo en el crecimiento intrauterino, para completar el presente reporte.

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INTRODUCTION

During normal pregnancy, the placental secretes important enzymes and hormones (1), and placental alkaline phosphatase (PAP) is one of such important enzymes. The rate of secretion or production of PAP has been observed to strongly correlate with the increasing nutritional demand of the growing foetus (2). PAP has been partly implicated in the processing of nutrients for foetal growth (3). Albeit, the relationship between PAP activity and the biochemical indices of foetal nutrition has remained scarce in our environment. It is on this note, that this investigation at-

tempts to determine the relationship between PAP activity and cord blood glucose, albumin and neonatal birth weight at term.

MATERIALS AND METHODS

Subjects

One hundred and five consenting and, apparently, healthy pregnant women with a gestational age of 39.2 ± 1.0 weeks, and who had uncomplicated deliveries at term, were selected from the Labour Unit, Central Hospital, Warri, Nigeria. The selected women were in the child bearing age (20-30 years) with no previous birth(s) and/or miscarriage(s). Also, they were not on any med-

ication outside the routine drugs such as folic acid, fesoate, B-complex, multivitamins and paracetamol. Previous births and medication could, respectively alter blood volume and composition, and induce metabolic and physiological changes that can influence biochemical parameters (1). It took about four months to get the 105 patients which were all the available subjects that fit into the study design. Informed consent was sought and obtained from the subjects and their participation was approved by both the hospital-based Ethics Committee and our Faculty's Bioethics and Research Committee. The study was conducted between April and July, 2006, in the Department of Medical Biochemistry, Delta State University, Abraka, Nigeria.

Determination of gestational age

The Ballard recommendation was used to estimate the gestational age. Each day was counted from the last menstrual period to delivery and reported in weeks.

Collection of blood samples

Maternal whole blood (3.0 mL for placental alkaline phosphatase activity assay) was collected from the maternal side of the placenta and foetal whole blood (3.0 mL for glucose and albumin estimation) was collected from the umbilical cord immediately after delivery by venipuncture using 21-gauge hypodermic needle and syringe. The samples were dispensed into plain, sterile bottles, allowed to clot and then, centrifuged at $1,200 \times g$ for 5 min at room temperature (29-31°C) using a Jouan C-400-54 model centrifuge. The sera (supernatant) samples obtained were decanted into bijoux bottles and stored frozen for analysis, which was performed within 48 hours of collection.

Analysis of samples

Maternal blood placental alkaline phosphatase (PAP) activity was assayed by

the Thymolphthalein Monophosphate method (4) using the maternal sera samples heated at 65°C for 7min.

The thermal treatment denatures other isoenzymic forms of alkaline phosphatase leaving the placental isoform which is heat-stable. This measure ensures that the activity value obtained was solely for the placental isotype.

The cord blood glucose concentration was determined by the Glucose Oxidase method (5) using cord blood specimens. Serum (cord blood) albumin level was estimated spectrophotometrically by the Bromocresol Green (BCG) method (6).

The reagents used for each assay were supplied in a commercial test kit by Randox Laboratories, Limited, United Kingdom.

Birth weight measurement

The weights of the neonates at term were determined by bathroom weighing scale designed for infants to the nearest 0.5 kg.

Statistics

Linear regression analyses adjusting for multiple confounders was used to confirm the association between PAP activity values and cord blood glucose, albumin and neonatal birth weight. PAP activity and birth weight were also correlated with gestational age.

RESULTS

Experimental values are shown on Table I. The mean placental alkaline phosphatase (PAP) value (115.5 ± 5.3) obtained, compares well with earlier values (7).

Correlation analyses show significant positive relationships between PAP and cord blood glucose ($r^2 = 0.86$, $p < 0.05$), albumin ($r^2 = 0.71$, $p < 0.05$), and birth weight ($r^2 = 0.68$, $p < 0.05$), but no significant correlation with gestational age. These

TABLE I
PLACENTAL ALKALINE PHOSPHATASE ACTIVITY VALUE AND INDICES OF FOETAL NUTRITION

Analytes	Mean \pm SD (n = 105)
Placental alkaline phosphatase (IU/L)	115.5 \pm 5.3
Cord blood glucose (mmol/L)	3.9 \pm 0.5
Cord blood albumin (g/L)	40.1 \pm 6.2
Neonatal birth weight (kg)	3.3 \pm 0.9
Gestational age at term (wk)	39.2 \pm 1.0

relationships were confirmed by regression analyses, adjusting for multiple confounder at 95% C.I.

DISCUSSION

PAP activity has been reported to increase as the gestational period advances (7, 8). This suggests that PAP supports pregnancy. Analyses of our results show that PAP activity could play some essential roles in nutrient (glucose and albumin) supply to the foetus as judged by the cord blood values and neonatal body weight at term. This may be so, because it has been reported that the placenta also produces insulinase enzyme, which destroys insulin, an important hormone needed for the transport of glucose into cells (2). This indicates that insulin may not be involved in the transport of glucose across the placental membrane. Also, gestational diabetes mellitus patients, with large-for-gestational age babies, did not show any demonstrated alternation in placental glucose transporters activities (9), and reduced mean corpuscular haemoglobin concentration has been observed to decrease both PAP activity and neonatal birth weight at term (10). These reports in addition to our findings (Table I), suggest that PAP may be involved in nutrient mobilization to the foetus.

However, in further studies, more subjects with a control group, perhaps fetuses

with intrauterine growth retardation (IUGR) should be investigated in order to verify our observation, which contributes to the accumulating information on foetal nutrition.

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