ORIGINAL ARTICLE

DETERMINATION OF GROWTH HORMONE, TESTOSTERONE AND ESTRADIOL IN CORD BLOOD AT THE UNIVERSITY OF MAIDUGURI TEACHING HOSPITAL

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ABSTRACT

Background: Cord blood provides data on problems of neonates including factors that may serve as indicators of future disorders. **Objectives:** To determine the values of growth hormone, testosterone and estradiol using cord blood. **Methods:** Cross-sectional study using Cord blood of babies born in the labour ward of the University of Maiduguri Teaching Hospital (UMTH) Borno State, Nigeria. The samples were analyzed in the Department of Medical Laboratory Science, Chemical Pathology Unit, University of Calabar, Nigeria. Enzyme- linked immunosorbent assay (ELISA) specific for the analysis of growth hormone, testosterone and estradiol was used. **Results:** Two hundred and eighty nine babies comprising 152 (52.8%) males and 137 (47.2%) females cord blood were analyzed. Nineteen were preterm and 270 were full term babies. The mean serum levels of estradiol and testosterone in both male and female babies were similar (2.47±0.31ng/ml male, 2.54±0.29ng/ml female and 1.73±0.60ng/ml male, 1.62± 0.64ng/ml female) respectively. The mean serum level of growth hormone in male was higher than that of female but not statistically significant (50.92±34.42ng/ml male and 45.95±30.87ng/ml). **Conclusion:** Cord blood Growth Hormone, testosterone and estradiol of male and female babies do not differ significantly at birth.

KEYWORDS : Growth hormone, sex hormones, cord blood.

INTRODUCTION

Testosterone plays a key role in the development of male reproductive tissues such as the testis and prostate as well as promoting secondary sexual characteristics. In addition, testosterone is essential for the prevention of osteoporosis[1,2]. The sexual differentiation of the mammalian fetus requires not only the genetic information carried on the sex chromosomes but also the hormonal secretions of the fetal testis, testosterone and Mullerian inhibiting hormone[3]. Estrogens are sex hormones that are responsible for the development and maintenance of the female sex organ and female secondary sexual characteristics such as breast, uterine growth and thickening of the endometrium[4]. There are many types of estrogen secreted by the ovary but the most potent is 17β-estradiol[4]. The developing brain expresses high levels of receptors for estradiol[5]. Male gonadal differentiation begins at 6-7weeks of gestation with organization of the gonadal blastema into interstitium and germ cell-containing testicular cords[6]. In females, differentiation of ovaries begins during the 7th week of gestation. At 12 weeks of gestation, primitive granulosa cells begin to replicate, and the numbers increase rapidly thereafter[7]. Interstitial cells with characteristics of steroid-producing cells are present after 12 weeks, and

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during the third trimester theca cells with steroidogenic capacity surround the developing follicles[8]. Growth hormone stimulates linear growth in children by acting on the epiphyseal plates of long bones[9]. It has specific metabolic effects on lipolysis, protein synthesis, and insulin action[9]. Apart from increasing height in children, growth hormone carries out many other metabolic functions such as increasing calcium retention and increasing the mineralization and strengthening of the bone. It also stimulates the growth of all internal organs and stimulates the immune system[10]. These hormones are essential for sexual maturation, growth and general body development, but there is no previous information on the status of cord blood values for these hormones in this environment. Hence the need for this base line determination.

MATERIALS AND METHODS

Cord blood samples of three hundred babies were collected consecutively in the labour ward of University of Maiduguri Teaching Hospital (UMTH) in three batches of one hundred in January, May and September of 2011 using convenience sampling. Ethical clearance was obtained from the Ethical Committee of the UMTH. Consent of the mothers was sought during the antenatal clinics and in the labour ward. Babies of mothers who consented and are apparently healthy during delivery were included in the research, whereas babies whose mothers had known history of diabetes mellitus, hypertension, eclampsia, Goiter, and those on chronic medication for any reason were excluded from the study. Babies born < 32 weeks of gestation and post date (> 43 weeks gestation) were also excluded. After delivery of the baby, the cord was double clamped and divided, the placental end of the cord was cleaned with dry gauze and the umbilical vein identified. Five-milliliter syringe and needle was used for the aspiration of 5mL of blood from the umbilical vein into a properly labeled clean plain specimen bottles and allowed to clot before it was centrifuged. The neonates were weighed with Bessinet neonatal weighing scale (SALTER England, Model 180) and their length were taken using standard measuring tape in the labour ward. The serum was stored in the refrigerator at - 20^{o}C for batch analysis.

Enzyme Linked Immunosorbent Assay kits specific for growth hormone, testosterone and estradiol obtained from DRG International, California, USA were used for the analyses. The serum testosterone and estradiol assays were performed as described by Ratcliff et al[11] while growth hormone analysis as described by Reiter et al[12]. Data were analyzed using SPSS version 18 for student "t" test and Pearson correlation coefficient. The differences was considered statistically significance at $p < 0.05$.

RESULTS

Of the three hundred samples, 289 were analyzable. One hundred and fifty two (52.6%) of the 289 babies were males and one hundred and thirty seven (47.4%) were females. There were nineteen (6.6%) preterm babies (gestational age 32-36 weeks), and two hundred and seventy (93.4%) full term babies (gestational age 37-42 weeks). The mean values of GH, testosterone and estradiol levels in preterm babies were compared with those of full term babies (table 1) but the differences were not statistically significant (testosterone p=0.10, estradiol p=0.16). The mean serum levels of estradiol and testosterone in both male and female babies were similar although the mean serum level of growth hormone in male was higher than that of female; this difference was not statistically significant (table 2). Pearson correlation analysis between GH and testosterone showed positive significant correlation (r=1.60; p=0.009, figure 1), and correlation between estradiol and testosterone (r=0.143; p=0.020) were also positive and statistically significant (figure 2). There was no significant correlation of any of the hormones studied with body mass index.

Table1: Comparison of cord serum growth hormone, testosterone and estradiol for Preterm and full Term babies

Group/parameters	Preterm (19)	Term (270)	p-value
GH (ng/ml)	45.04±31.01	48.74±32.93	0.94
Testosterone (ng/ml)	1.79±0.44	1.67±0.63	0.10
Estradiol (ng/ml)	2.48±0.33	2.51±0.30	0.16
BMI(kg/m^2)	12.24±2.41	13.65±2.25	0.32

Table2: Comparison of cord serum GH, testosterone and estradiol for male and female babies

Group/parameters	Male (152)	Female (137)	p-value
GH (ng/ml)	50.92±34.42	45.95±30.87	0.07
Testosterone (ng/ml)	1.73±0.60	1.62±0.64	0.32
Estradiol (ng/ml)	2.47±0.31	2.54±0.29	0.83
BMI(kg/m^2)	13.92±2.57	13.16±1.84	0.58

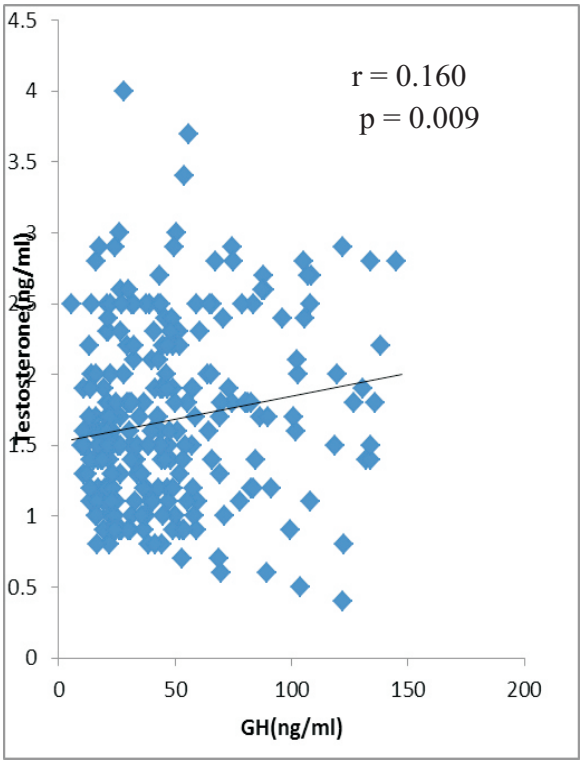

Figure 1: Scatter plot correlation between GH and Testosterone

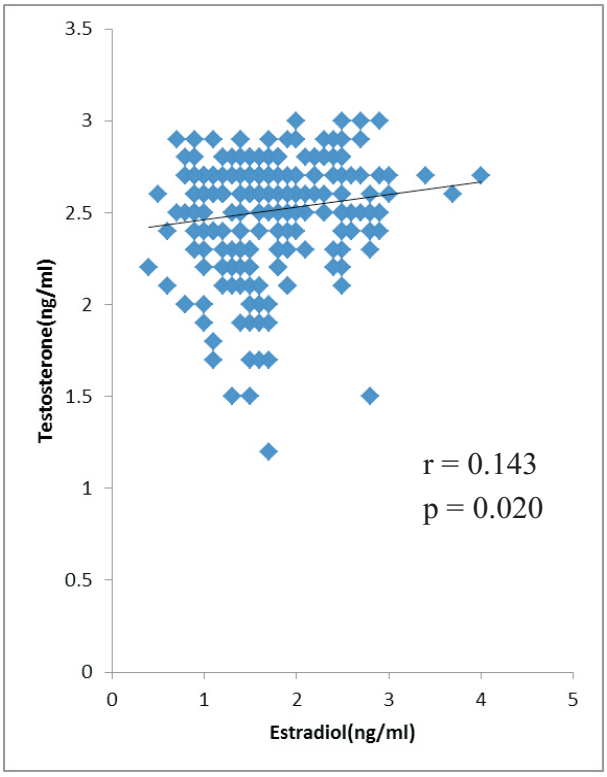

Figure 2: Scatter plot correlation between testosterone and estradiol

DISCUSSION

Cord blood is an important tool that is necessary for providing a guide for problems that concern neonates including factors that may serve as indicators of future problems. To the best of our knowledge, this is the first prospective study to examine the levels of growth hormone, testosterone and estradiol in babies using cord blood in UMTH. Our findings indicate that there were no significant differences in the values for all the hormones studied between the preterm and full term babies. There were no differences between male and female babies in any of the hormones studied, even in hormones like testosterone and estradiol. This is contrary to the findings in human adults where on average, males produce about ten times more testosterone than females[13]. On the other hand, adult women in reproductive age produce higher levels of estrogen than adult males[13]. Our study showed a significant correlation between GH and testosterone. The acceleration in linear growth during normal puberty in man is attributed mostly to the combined physiological effects of the somatotrophic and gonadal axes because high pulsatile release of growth hormone concomitant with an increase in testosterone concentrations becomes evident in pubertal development[14]. Both hormones are therefore required for growth and development. In addition, there was a significant correlation between estradiol and testosterone. During pregnancy, the majority of circulating testosterone is normally bound to sex hormone binding globulin (SHBG) or albumin. However, the free fraction is physiologically active. Circulating sex hormone binding globulin concentrations are known to be increased in pregnancy because of raised level of sex steroid hormones. This frequently leads to reduced level of free sex steroid such as testosterone in the circulation. Increase in testosterone is followed by peripheral conversion to estradiol and this increases circulating estradiol[15]. This means that increase in testosterone will lead to increase in estradiol, and hence the positive correlation. A study by MacDonald et al[16] revealed that in adult, as body mass index increases, there is proportionate reduction in testosterone levels. In this study, there is no correlation between testosterone levels in neonates and body mass index.

Many other studies have reported values for neonatal cord blood growth hormone that varied from 20.07±8.38ng/ml to 41.7±3.6ng/ml for full term neonates [17-19]. The GH values obtained in our study for preterm and full term babies were 45.04±31.01ng/ml and 48.74±32.93ng/ml respectively.

In this study, there are no differences between male and female babies cord serum estradiol and testosterone. This agrees with the findings of Ines et al[20] and contradicts that of Francis et al[21] who stated that differences exist between the sexes in cord serum testosterone. However, regional differences even at this age have been reported; Chinese neonates were found to have higher levels of estradiol and testosterone than neonates in United States of America[22]. Our mean estradiol and testosterone values are 2.51±0.30ng/ml and 1.67±0.63ng/ml respectively. The estradiol in our study is lower than that of Lagiou P et-al[22], however our testosterone values are similar to those found by Todd et al[23]. We believe that the variation in estradiol may have racial or demographic implications. Adeyemo and Jeyakumar[24], measured testosterone and estradiol in 22 male and 30 female neonates and had values of 8.4±1.2ng/ml for testosterone and 5.0±0.3ng/ml for estradiol, which is lower than that in our study, although their samples size was small compared to this study and the environment may have contributed to the variation.

In conclusion, this study indicates that cord blood GH, testosterone and estradiol of male and female babies do not differ significantly at birth. Geographic, racial and ethnic differences may be responsible for some of the variations observed in different studies. ■

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