ORIGINAL ARTICLE

Assessment of Serum Reproductive Hormone Concentrations in Normal Pregnancy

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Abstract

Background and objectives: Gestation is associated with profound hormonal and metabolic changes in the mother. These alterations facilitate the placenta to take over the dominant role of steroid production. The present study was designed to assess the concentrations of estrogen, progesterone, and total testosterone in normal pregnancy.

Materials and methods: Fifty normotensive normal pregnant subjects with mean age 26.4 ± 4.48 years with no history of hypertension, vomiting, fever, cough, and cold were taken. Their mean ± SD gestational age at the time of study was 23.8 ± 10.2 weeks, who attended to the gynecology OPD were included in the study. Age-matched 50 nonpregnant subjects, not having any acute illness, thyroid, liver, and renal diseases, were taken as control. Serum estrogen, progesterone, and total testosterone were estimated by chemiluminescent method on Immulite 1000.

Results: The alterations of serum reproductive hormone levels in normotensive pregnant subjects were found when compared to those of non-pregnant control group. Study group showed a significant (p value < 0.001) increase in serum estrogen, progesterone, and total testosterone levels due to production of prostaglandin before labor, subsequent conversion of cholesterol to progesterone in the placenta, and defect in newborn growth and size, respectively. When compared to nonpregnant control group.

Conclusion: Reproductive hormones such as estrogen, progesterone, and total testosterone in normal pregnancy are of paramount importance during pregnancy. This study suggests that levels of abovementioned parameters were altering in normal physiological changes during pregnancy.

Keywords: Estrogen, Pregnancy, Progesterone.

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Introduction

Reproductive hormones are responsible for growth, development, maintenance, and regulation of reproductive system. They are essentially required for the development of germ cell.[1] During pregnancy, human body undergoes several changes in the process of its adaptation to the growing fetus. Although these changes are physiological, there is potential for morbidity and mortality to both mother and fetus.[2] The gonadotropins of the anterior pituitary regulate secretion of the ovarian hormones, estradiol and progesterone; hypothalamic control of pituitary gonadotropin production is in turn regulated by plasma concentration of the estradiol and progesterone. During pregnancy, the placenta becomes the main source of estrogen.[3,4]

Testosterone in the female comes from three sources such as secreted in small quantities by both the adrenal glands and the ovaries, and in healthy women, 50–60% of the daily testosterone production arises from peripheral metabolism of prehormones, chiefly androstenedione.[5] Several studies have shown that sex hormone levels in serum altered during pregnancy.[6–9] We have performed this study to confirm the alteration in concentrations of serum estrogen, progesterone, and total testosterone in normal pregnancy.

Materials and Methods

This study was carried out at Department of Biochemistry, Grant Medical College and Sir JJ Group of Government Hospitals, Mumbai, over the period of October 2007–June 2010. All participants completed a medical history form and provided informed consent. Fifty normotensive pregnant subjects with mean age 26.4 ± 4.48 years who had no history of hypertension, vomiting, fever, cough, and cold were taken. Their mean ± SD gestational age at time of study was 23.8 ± 10.2 weeks who attended to the gynecology OPD were included in the study. Age-matched 50 nonpregnant subjects had regular ovulatory cycle and not having any acute illness, thyroid, liver, renal diseases, and not used oral contraceptives were taken as control. The Institutional Ethical Committee at the Grant Medical College and Sir JJ Group of Government Hospitals, Mumbai, India, approved the study.

Blood Sample Collection

Venous blood samples were collected in test tube with aseptic precautions. After 2 hours of collections sample was centrifuged at 3,000 rpm for 5 minutes. Serum was separated and collected in polythene tube with cork. The sera with no sign of hemolysis used for the analysis of estrogen, progesterone and total testosterone.

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Biochemical Analysis

Serum estradiol measured by solid-phase, competitive, chemiluminescent enzyme immunoassay.[10] Serum progesterone measured by sequential, competitive, chemiluminescent immunoassay.[11] Serum total testosterone measured by solid-phase, competitive, chemiluminescent enzyme immunoassay.[12] We used fully automated enzyme-amplified chemiluminescent immunoassay-based Immulite 1000 analyzer. Measurement of these blood parameters was done using commercial kits from Siemens Medical Solutions Diagnostics, Los Angeles, CA, USA.

Statistical Analysis

Numerical variables were reported in terms of mean and standard deviation. Statistical analysis of results was done by normal distribution '*z*' test. In this analysis, variables showing *p* value less than 0.05 and 0.001 were considered to be statistically significant and highly significant respectively.

Results

Demographic data of pregnant subjects such as age and hemoglobin (Hb) were significantly changed (p value < 0.05), whereas body mass index (BMI), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were statistically insignificant when compared to those of non-pregnant control group (Table 1).

Table 2 shows levels of serum estrogen, progesterone, and total testosterone in nonpregnant healthy subjects and pregnant cases. Study group showed a significant (p value < 0.001) increase in serum estrogen, progesterone, and total testosterone when compared to nonpregnant control group.

Table 1: Demographic data in non-pregnant controls and pregnant subjects

S. no.	*Biochemical parameters*	*Non-pregnant (n = 50)*	*Normotensive pregnant (n = 50)*
1.	Age (years)	25.4 ± 4.96	26.4 ± 4.48*
2.	Gestation age (wks)	00 ± 00	23.8 ± 10.2*
3.	BMI (kg/m^2)	20.8 ± 3.38	21.9 ± 4.78^{NS}
4.	SBP (mm of Hg)	120 ± 6.46	122 ± 6.45^{NS}
5.	DBP (mm of Hg)	79.7 ± 4.23	81.8 ± 4.78^{NS}
6.	Hb (g/dL)	11.3 ± 1.10	10.2 ± 1.09*

The results were compared between control group and study group of pregnant subjects. The values are presented in mean ± S.D. *$p < 0.05$

Table 2: Serum reproductive hormones in non-pregnant controls and pregnant subjects

S. no.	*Biochemical Parameters*	*Non-pregnant (n = 50)*	*Normotensive pregnant (n = 50)*
1.	Estradiol (pg/mL)	54.4 ± 24.5	2486 ± 755**
2.	Progesterone (ng/mL)	0.98 ± 0.47	82.7 ± 18.5**
3.	Testosterone (ng/dL)	49.7 ± 16.9	84.2 ± 23.7**

The results were compared between control group and study group of pregnant subjects. The values are presented in mean ± S.D. **$p < 0.001$

Discussion

Gestation is associated with profound hormonal and metabolic changes in the mother. These alterations facilitate the placenta to take over the dominant role of steroid production.[6] The present study showed highly significant increase (p value < 0.001) in serum estradiol levels in patients with normotensive pregnancy when compared to that of nonpregnant control group. Progressively increased concentration of estradiol was observed during pregnancy. Similar findings of estradiol hormone were reported by Mathur et al.[7] The increased synthesis of estradiol after 30th week of gestation is due to production of prostaglandin before labor. Estrogenic activity is effected via estradiol–receptors complexes that trigger the appropriate response at the nuclear level in target sites (follicle, uterus, breast, vagina, urethra, and hypothalamus).[6]

Serum progesterone concentrations were significantly increased (p value < 0.001) in normotensive pregnant subjects when compared with that of non-pregnant controls. Similar to our results, Khan et al. also observed overall increased serum progesterone levels in normal pregnant women.[7] The concentration of progesterone second trimester of gestation is increased due to maybe placental extraction of maternal cholesterol with subsequent conversion in the placenta to progesterone.[8] In our study cases, majority of patients were in second trimester of pregnancy.

We observed highly significant increase (p value < 0.001) in serum total testosterone levels in normotensive pregnant group when compared to that of nonpregnant control group. Maternal serum testosterone levels might be increased because of defect in newborn growth and size through several potential mechanisms. Maternal testosterone may modify her energy homeostasis and thus decrease nutrient supplies to the placenta and fetus. Carlsen et al. and Hohlagschwandtner et al. showed increment of serum testosterone levels in pregnancy.[9,13] Our findings in Indian women are in fair agreement with those of Carlsen et al. and Hohlagschwandtner et al.

We can conclude that reproductive hormones, such as estrogen, progesterone, and total testosterone in normal pregnancy, is of paramount importance during pregnancy. This study suggests that levels of abovementioned parameters were altering in normal physiological changes during pregnancy. Our study indicates no major deviation with previous study.

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