

Effect of gestation stages on the levels of T3, T4 and TSH in pregnant rats

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Abstract

This study presents the effects of gestation periods on the concentration of T3, T4 and TSH concentration in blood of pregnant rats.

Forty adult albino female albino rats were divided randomly into four groups (10/group), first group was not mated considered as control group and the other groups (G1, G2 and G3), G1: pregnant rats at the first third of gestation (0-7 days of gestation), G2: pregnant rats at the second third of gestation (7-14 days of gestation) and the G3: pregnant rats at the last third of gestation (14days-end of gestation).

Blood samples were collected to determine serum T3, T4 and TSH level.

The results showed that there was significant ($P<0.01$) increase in serum T3, T4 and TSH concentration in samples calculated from pregnant animals, in comparison with the non-pregnant ones. That's related with normal increment in metabolic rate in pregnant in contrast with non-pregnant.

Introduction

The thyroid gland, located immediately below the larynx on each side of and anterior to the trachea, is one of the largest of the endocrine glands. Its secretes two major hormones, *Thyroxine* and *Triiodothyronine*, commonly called T4 and T3, respectively. Both of these hormones profoundly increase the metabolic rate of the body[1].

Complete lack of thyroid secretion usually causes the basal metabolic rate to fall 40 to 50 percent below normal, and extreme excesses of thyroid secretion can increase the basal metabolic rate to 60 to 100 percent above normal. Thyroid secretion is controlled primarily by *thyroid-stimulating hormone (TSH)* secreted by the

anterior pituitary gland. The thyroid gland also secretes *calcitonin*, an important hormone for calcium metabolism [2].

TSH, also known as thyrotropin, is an anterior pituitary hormone, a glycoprotein with a molecular weight of about 28,000. This hormone, increases the secretion of thyroxine and triiodothyronine by the thyroid gland. Its specific effects on the thyroid gland (TSH increases all the known secretory activities of the thyroid glandular cells). [3]

Increased thyroid hormone in the body fluids decreases secretion of TSH by the anterior pituitary. When the rate of thyroid hormone secretion rises to about 1.75 times normal, the rate of TSH secretion falls essentially to zero. [4]

The aim of this study is to discuss the formation and secretion of the thyroid hormones, their metabolic functions, and regulation of their secretion and the relationship between thyroid hormones with the gestation periods.

Materials and Methods

Animals:

Forty sexually mature 6-8 weeks old female albino rats were used in the present study. The animals were housed in cages in a room maintained at 22 ± 1 °C with 12 hours dark/ light cycle and had access to food and water ad libitum.

Experimental Design:

After the adaptation period, the rats were randomly divided into four groups (10 of each):

Control Group: Animals of this group were not mated with males.

G1 Group: Animals of this group mated with adult males, and determine pregnancy by vaginal smear, blood samples were collected after (0-7day) of gestation.

G2 Group: Animals of this group mated with adult males, and collected blood after 7-14 day of pregnancy.

G3 Group: Animals of this group mated with adult males, and collected blood after 14 day to the end of gestation.

The animals were anesthetized by injection of ketamine 90 mg/kg B.W., xylozine 40 mg/kg B.W. Blood samples were obtained via cardiac puncture, centrifuged, and then serum samples were stored

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in freezer at -18°C for measurement of T3, T4 and TSH was detected by using of mini VIDAS by RIA method.

Results and Discussion

Statistical estimates on the variables researched for members of samples by duration of pregnancy.

(Control group)		G3		G2		G1		Variable hormone
y	x	y	x-	y	x-	y	x-	
0.556	1.707	0.708	2.589	0.491	2.84	0.417	1.647	T3
10.306	85.891	13.375	98.311	12.485	122.12	11.257	108.58	T4
1.003	1.773	1.915	2.724	1.091	3.478	0.721	3.777	TSH

Table (1), showed the values accruing to the media and standard deviations between all values in pregnant in all periods and control groups, the values of (T3) divided respectively: (1.647, 2.84, 2.589, 1.707), and standard deviation respectively: (0.417, 0.491, 0.708, 0.556). While values of (T4), divided respectively: (108.58, 122.12, 98.311, 85.891), and standard deviations values in are: (11.257, 12.485, 13.375, 10.306), and finally the values of (TSH), were respectively: (3.777, 3.478, 2.724, 1.773), and the amount of standard deviations in a row: (0.721, 1.091, 1.915, 1.003).

Table (2) shows significant ($P < 0.01$) and non-significant ($P > 0.01$) differences between the mathematical community levels of hormone (T3), at duration of pregnancy, (Tuoiiki test).

Statistical significant	Tuoiiki value	Differences between mathematical community	Groups according a duration of pregnancy	hormone
Significant ($P < 0.01$)	6.591	1.193	G1group – G2 group	T3
Significant ($P < 0.01$)	5.204	0.942	G1group - G3 group	
Non-significant ($P > 0.01$)	0.331	0.06	G1 group - Control group	
Non-significant ($P > 0.01$)	1.387	0.251	G2group – G3 group	
Significant ($P < 0.01$)	6.26	1.133	G2group – Control group	
Significant ($P < 0.01$)	4.873	0.882	G3group – Control group	

The table (2) showed the significant and non-significant differences of T3 values between pregnant and non-pregnant animals and showed the significant ($P < 0.01$) and non-significant differences ($P > 0.01$) within groups of pregnant animals, so, the results showed that the non-significant ($P > 0.01$) differences between G1group and Control group, there values showed in Table: 1.

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There was a significant increment ($P < 0.01$) in level of T3 between G1 group and G2 group that's mean increment in level of T3 with time of gestation. There was a significant ($P < 0.01$) differences in level of T3 between G1group and G3group. Non-significant differences ($P > 0.01$) between group and G3 group. There was significant differences ($P < 0.01$) between and G2 group and Control group (non-pregnant), there was a significant differences between Control group (non-pregnant) and G3 group.

Table (3): significant ($P < 0.01$) and non-significant ($P > 0.01$) differences between the mathematical community levels of hormone (T4):

The table (3) showed the significant and non-significant differences

Statistical significant	Tuiki value	Differences between calculating community	Groups according to pregnancy preiods	Variable hormone
Non-significant ($P > 0.01$)	3.388	13.54	G1group – G2 group	T4
Non-significant ($P > 0.01$)	2.57	10.269	G1group - G3 group	
Significant ($P < 0.01$)	5.678	22.689	G1 group - Control group	
Significant ($P < 0.01$)	5.958	23.809	G2group – G3 group	
Significant ($P < 0.01$)	9.066	36.229	G2group – Control group	
Non-significant ($P > 0.01$)	3.108	12.42	G3group – Control group	

of T4 values between pregnant and non-pregnant animals and showed the significant ($P < 0.01$) and non-significant differences ($P > 0.01$) within groups of pregnant animals, the results showed that the significant ($P < 0.01$) differences between G1 group and Control group, there values showed in Table: 1.

There was a non-significant ($P > 0.01$) differences between (G1 and G2) nor (G1 and G3) in level of T4 as showed by tables (1-2). There was a significant ($P < 0.01$) differences in level of T4 between G2 and G3. There was significant differences ($P < 0.01$) between and G2 and Control group (non-pregnant). No significant differences between G3 group and control group.

Table (4): significant ($P < 0.01$) and non-significant ($P > 0.01$) differences between the mathematical community levels of hormone (TSH), at duration of pregnancy, (Tuoiki test).

Statistical significant	Tuiki value	Differences between calculated community	Groups according to the duration of pregnancy	Variable hormone
Significant ($P < 0.01$)	3.938	1.705	G2group – Control group	TSH
Non-significant ($P > 0.01$)	0.691	0.299	G1group – G2 group	
Non-significant ($P > 0.01$)	2.432	1.053	G1group - G3 group	
Significant ($P < 0.01$)	4.628	2.004	G1 group - Control group	
Non-significant ($P > 0.01$)	1.741	0.754	G2group – G3 group	

The table (4) showed the significant and non-significant differences of TSH values between pregnant and non-pregnant animals and showed the significant ($P < 0.01$) and non-significant differences ($P > 0.01$) within groups of pregnant animals, the results showed that the significant ($P < 0.01$) differences between G1 group and Control group, there values showed in Table: 1.

There was a non-significant ($P > 0.01$) differences between (G1 and G2) nor (G1 and G3) in level of TSH as showed by tables (1-2). There was a non-significant ($P > 0.01$) differences in level of TSH between G2 and G3. There was significant increment ($P < 0.01$) between and G2 and Control group (non-pregnant). No significant differences between G3 group and control group (non-pregnant).

As a general, the results showed increment (in almost) in the levels of T3, T4 and TSH hormones with the stages of pregnancy in contrast with non-pregnant rats.

Discussion

During pregnancy, estrogen production increases progressively elevating the mean TBG (Thyroid Binding Globulin) concentration. TBG levels plateau at 2 to 3 times the pre-pregnancy level with gestation. This rise in TBG results in a shift in the T4 and T3 reference ranges to approximately 1.5 times the non-pregnant levels with gestation. These changes are associated with a fall in serum TSH during the first trimester, such that subnormal serum TSH may be seen in approximately 20 % of normal pregnancies. This decrease in TSH is attributed to the thyroid stimulating activity of Human chorionic gonadotropin (HCG) that has structural homology with pituitary TSH. The peak rise in HCG and the nadir in serum TSH occur together at about first and second thirds of gestation. In approximately 10 % of such cases (i.e. 2 % of all pregnancies) the increase in free T4 reaches supranormal values and, when prolonged, may lead to a syndrome entitled "gestational transient thyrotoxicosis"[5].

(GTT) that is characterized by more or less pronounced symptoms and signs of thyrotoxicosis. Increases in total T4 and T3. Plasma concentrations of total T4 and T3 are also increased during pregnancy, often outside the health-related reference interval. Total T4 and total T3 concentrations increase sharply in early pregnancy and plateau early in the second trimester at concentrations 30–100% greater than pre-pregnancy values. The etiology of this increase in total circulating thyroid hormones involves, primarily, increased concentrations of plasma TBG. Another

proposed mechanism for this increase in total thyroid hormone concentrations is production of type III deiodinase from the placenta [6]. This enzyme, which converts T4 to reverse T3, and T3 to diiodotyrosine (T2), has extremely high activity during fetal life. Increased demand for T4 and T3 has been suggested to increase production of these hormones with, ultimately, increased concentrations in the circulation. The increase in T4 and T3 and TSH concentrations is less than would be expected by the increase in TBG [7]. This as a "relative hypothyroxinemia". As discussed below, this is reflected by a decrease in free T4 concentrations as well as a progressively decreasing T4/TBG ratio during pregnancy. Changes in free T4 and T3 and TSH concentrations during pregnancy have been controversial. Some authors have reported a decrease in free hormones, whereas others have reported no change or even an increase [8]. These discrepancies may have been attributable to the techniques used for free hormone measurement. Demonstrated variability in serum free thyroid hormones in pregnant women at term among 10 commercially available methods [9].

Other studies have confirmed that serum free T4 and T3 and TSH are; 25% lower at delivery than non-pregnant subjects. However, in human, most pregnant (78%) remain within the same reference interval as non-pregnant women [10]. At the pregnancy the metabolic rate was increased that need increment in level of T3, and T4 related with TSH due to the lack of thyroid secretion usually causes the basal metabolic rate to fall 40 to 50 per cent below normal, and extreme excesses of thyroid secretion can increase the basal metabolic rate to 60 to 100 per cent above normal. Thyroid secretion is controlled primarily by *thyroid-stimulating hormone (TSH)* secreted by the anterior pituitary gland [11]. The thyroid gland also secretes *calcitonin*, an important hormone for calcium metabolism. [2]

Increased thyroid hormone in the body fluids decreases secretion of TSH by the anterior pituitary. When the rate of thyroid hormone secretion rises to about 1.75 times normal, the rate of TSH secretion falls essentially to zero. Almost all this feedback depressant effect occurs even when the anterior pituitary has been separated from the hypothalamus. Therefore, it is probable that increased thyroid hormone inhibits anterior pituitary secretion of TSH mainly by a direct effect on the anterior pituitary gland itself. Regardless of the mechanism of the feedback, its effect is to

maintain an almost constant concentration of free thyroid hormones in the circulating body fluids. [4, 12]

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تأثير مراحل الحمل المختلفة على مستوى هرمونات T3 و T4 و TSH في دم الجرذان الحوامل

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الخلاصة

اجريت هذه الدراسة للتعرف على تأثير فترات الحمل المتعاقبة على تركيز كل من هرمون T3 و T4 و TSH في دم الجرذان الحوامل.

تم اجراء هذه التجربة في البيت الحيواني التابع لقسم علوم الحياة/ كلية العلوم- جامعة المثنى أجريت على 40 من الجرذان الاناث البالغة نوع الالبينو والتي قد قسمت عشوائيا الى اربعة مجاميع بواقع 10 جرذان/مجموعة وقد قسمت كالاتي: 1. مجموعة السيطرة: عشرة من الاناث التي تركت بدون تزاوج لاستخدامها كمجموعة مقارنة (سيطرة) 2. مجموعة (G1): تتضمن عشرة جرذان قيست مستويات هرموناتها في الثلث الاول من الحمل (0-7) يوم 3. مجموعة (G2): تتضمن عشرة جرذان تم قياس مستويات هرموناتها في الثلث الثاني من الحمل (7-14) يوم 4. مجموعة (G3): تتضمن هذه المجموعة عشرة جرذان واقعة ضمن الثلث الاخير من الحمل (14- نهاية الحمل).

جمعت العينات لغرض قياس مستويات هرمونات T3, T4 و TSH في مصل الدم عن طريق الوخز القلبي من كل المجاميع لغرض المقارنة مع مجموعة السيطرة.

أظهرت النتائج مستويات مختلفة من الهرمونات التي يقوم كل منها بدور معين اثناء فترة الحمل حيث أظهرت النتائج زيادة واضحة ($P < 0.01$) في مستويات الهرمونات مع التقدم في فترة الحمل لتصل الى اعلى مستوياتها كما في حالة هرمونات T3 و T4 التي تفرز من الغدة الدرقية وبصورة اقل كان التأثير على مستويات هرمون TSH في العينات التي اخذت من الاناث الحوامل عند مقارنتها بالاناث الغير حوامل.