Study of Some Biochemical Changes in Some Organs of Pregnant Women

Ilham Abd Allah Ali Al-Saleem
Department of Biology, College of Science,Al-Mosul University, Mosul, Iraq
Email: elham_alsaleem@yahoo.com

Abstract

Conception is a naturalistic physiological report with biochemical, molecular and hormonal alterations that assists the existence and growth of the embryo. Aim of study was to investigate the concentration of thyroid stimulating hormone (TSH), alkaline phosphatase (ALP), and serum electrolyte sodium (Na), potassium(P) and chloride (Cl) in pregnancy. Materials and methods: 22 healthy pregnant females and11 healthy non pregnant females at the age of 15-49 years. Eleven of pregnant females in the first three month of pregnancy and another eleven in the last three month of pregnancy. Blood was pulled and centrifuged to obtain the serum then the serum place in small tubes and stored in -20Co to use it in measure of TSH, ALP and electrolyte (Na,P, Cl). Results: The study found that there is anon significant increase in TSH in first trimester and anon significantly reduce in the level of TSH in third trimester when compared with control group and there is a significant low in the level of ALP in the first and third trimester of pregnancy when compared with control collection. The study also found that there is anon significant decrease in Na, P in the first three month and significant increase in the last three month of pregnancy compared with control collection. There is anon significant increase in the concentration of chloride Cl in the first and anon significant decrease in the third trimester when compared with control group. Conclusions: There is an alteration in the concentrations of TSH, ALP, Na, P and Cl.

Keywords: Pregnant Women; TSH; ALP; Serum Electrolytes

1. Introduction

Pregnancy is accompany with many biochemical alterations,one of the most hormones affect is thyroid hormones. Thyroid diseases are generally more common in females than males, in a recent study, it was found that thyroid diseases are distributed in about (82.60%) females and about (17.39%) males [1].

Thyroid efficacy suffers alterations during pregnancy, involving the evolution of maternal goiter particularly in iodine- minus regions [2],a two- to threefold raise in thyroxine-binding globulin levels [2, 3], a 30-100% rise in thyroxine and total triiodothyronine levels, and rise of the clearance of renal iodide [4].It is also escorted by immunologic alterations, majorly recognized by a transfer from a T helper-1 (Th1) lymphocyte to a Th2 lymphocyte situation. Thyroid peroxidase antibodies are existent in 10% of women at fourteen weeks' gestation, and are linked with an elevated pregnancy failure for example an elevated occurrence of gestational thyroid dysfunction, a willingness to postpartum thyroiditis and abortion.

Serum (TSH) rate is the index for the control and assessing thyroid function [5, 6].The American Thyroid Association (ATA) guideline 2011 advised the pregnancy trimester-specific standard of TSH level for the recognize of subclinical hypothyroidism [7]. They determined reference scopes for first trimester, about 0.1–2.5 mIU/L; second three month of pregnancy, about 0.2–3.0 mIU/L; and about 0.3–3.0 mIU/L in the third trimester of pregnancy (Alexander etal.,2017).Other study confirm that gravid women with increased TSH concentrations had an elevated hazard of miscarriage in the first three month of pregnancy and that, the level of TSH 2.5 -4.87 mIU/L elevated the hazard of abortion, with TSH major than 4.87 mIU/L raising the hazard more than these [8].

One of another disturbance during pregnancy is abnormalities in liver function tests (LFT) which are a generally problem related with dangerous outcome particularly when it appears in the third trimester [9].The abnormal (LFT) during pregnancy came from hyperemesis gravidarum (HG) [10] intrahepatic cholestasis of pregnancy [1], haemolysis-high liver enzymes-low platelets (HELLP), pre-eclampsia, and scarcely acute fatty liver of pregnancy which can give rise to maternal and fetal mortality and morbidity [11]. All scores of the function of liver are mostly decreased through pregnancy due to the extension of extracellular fluid therefore the total bilirubin,serum albumin and transaminases (ALT and AST) are decrease in contrast with the non-pregnant situation [11].Also there were significant elevation in low-density lipoprotein cholesterol, triglycerides, total cholesterol, glucose, and reduce in high-density lipoprotein cholesterol concentrations through pregnant women in contrast with non-pregnant women [4].

Serum electrolytes is another disturbance during pregnancy specially in pregnant preeclampsia because it causes vascular endothelial disturbance. The preeclampsia is hypertension with the secretion of approximately >300 mg of urinary protein for every day after twenty weeks of pregnancy [12] which infect approximately 5–14% worldwide pregnancies and cause disturbance for the maternal and fetal [13].

The decreased serum sodium and potassium concentration in pregnant with preclampsia when compared with normal pregnant, led to believe that the electrolytes alterations may be connected with preeclampsia [14].

Chloride (Cl) is important for the hegemony of acid/base equilibrium, hydration and osmotic pressure. The allocation is deviate towards high hesitancy of reduced levels and could be attributed to electrolytes disorder in some pregnant women that may be due to malnutrition,

doi.org/10.31838/hiv22.02.316 Received: 08.05.22, Revised: 10.07.22, Accepted: 07.08.22

vomiting [15, 16], drugs and low fluid intake [15, 16], loss of acid from the body with chronic diarria.

2. Materials and Methods

Chosen of study subjects

Based on exclusion and inclusion gauge total 33 women (22cases and 11 controls) were choose for this study. The data and information of pregnant women was register. 11 healthy non pregnant females 22 healthy pregnant females, at the age of 15-49 years of gravid females 11 in the first trimester (1-≥13 weeks of gestation), and 11 in third trimester (27-≥40weeks) from general laboratories and from the families and relatives in Mosul city.

Exclusion guage

The women of the story of chronic maladies that was appeared prior pregnancy (For instance a story of diabetes mellitus (DM) or who are depending on insulin remedy, women having anti-hypertensive medicines of liver malady patients) are eliminate.

Gathering of Blood samples

Approximately of 4ml of blood from vein was pulled under aseptic causions from nomination subjects. The samples of blood were centrifuged at about 3000 rpm for approximately10 minutes to gain the serum,that placed in a small tubes and stored in -20 Co to utilize it for the measurement of parameters.

Measuring of parameters

The parameters which were to be deliberate in the pregnant and non-pregnant are TSH, ALP and electrolyte (Na, K &CL) serum of pregnant.

Normal ranges

Normal ranges for TSH, was 0.35–4.5 mU/l [17].

The Alkaline phosphatase standard in normal adults should be 20–140 units per liter (U/L) PubMed Central.

Highly respected database from the National Institutes of Health

The disorder of electrolyte defined according to the reference extents for adults of the central laboratory of the Inselspital,University Hospital Bern:

Hypernatraemia >145 mmol/ l: hyponatraemia <135 mmol/l; hyperkalaemia >4.7 mmol/; hypokalaemia <3.5 mmol/l; hyperchloraemia >108 mmol/l; hypochloraemia <97 mmol/l; [17].

3. Statistical Analysis

The research data were resolved based on the simple experiments system and with the complete random design. The parameters were tested according to the Dunkin multi-range test. The diverse factors were recognized significantly by various alphabets characters.

4. Results and Discussion

TSH hormone concentration during pregnancy

This study found that the concentration of TSH in control group about (0.58 to 4.4) mIU/L where is in first trimester pregnant woman about (0.866 to 4.81) mIU/L and in third trimester pregnant woman about(0.452 to 3.01) mIU/L, this study matched with other previous study that found the concentration of TSH in control group about (0.15–5.66) mIU/L and in first three month about (0.25–6.65) mIU/L [18].

The results of this study found that there is none significant increase of the concentration TSH hormone in first trimester of pregnant woman when compared with control group see table (2) and agree with a previous study [11] and also another study that showed that the level of TSH in first trimester reach>2.5mIU/L [19].

Another study was not agreed with this study that found the serum concentrations of TSH are decreased in the first trimester.

TSH of pregnant women at the age of 24-35 years

This study show that the level of TSH hormone significantly increase in the age 25-34 in first trimester and third trimester when compared with 15-24 year and when compared with control collection see table (1).

The results of this study found that TSH hormone generally increased at this age when compared with pregnant at the age of 15-24 years.

In elderly,there is a high level of TSH with a hypothyroidism [8].

The result of this study found that the level of TSH hormone increased in first trimesters than third.

The level of TSH hormone is decreased in third trimester because of the secretion and synthesis of thyroid hormone planned by embryonic pituitary TSH follow at about twenty weeks of pregnancy [20].

Alkaline phosphatase concentrations during pregnancy

This study show that the level of ALP enzyme significantly decrease in elder pregnant more than in younger pregnant in first trimester when compared with control group and in third trimester they decreased significantly in younger pregnant more than in elder pregnant when compared with control group. see table(1).

The ALP levels in non-pregnant women were 131U/l where is in first trimester was 57.81U/l and in third trimester were 71 U/l.

This study found that there is a significant reduce of the level of ALP enzyme in the first trimester and third trimester of pregnancy when compared with control group. See table (2).

From the results of this study, it is found that in first trimester especially elder pregnant there is high level in TSH that come from low level of thyroid hormones [19] which cause low level of alkaline phosphatase [10].

The level of liver enzyme activities and Total bilirubin elevated significantly in both hypothyroid and hyperthyroid subjects. The relationships between liver enzymes and thyroid hormones were positive in hyperthyroid matters and negative in hypothyroid matters and vice-visa [21].

Another previous study that carried out on 373 samples of serum, 91% were obtained during the third trimester of pregnancy. The concentration of ALP in serum was 68.2 U/l in first trimester and 75.9 U/l in second trimesters and increased to 126.7, 178.8 and 234 U/l in the third

trimester [22]. Also other study confirm that there is a threefold to fourfold elevated in the concentration of ALP in pregnant woman [6].

Table1:The concentration of (TSH hormone mIU/L and ALP enzyme U/l)in different age categories						
ALP Enzyme			TSH Hormone			
Third trimester	First trimester	Control	Third trimester	First trimester	Control	Age Categories
47.0±9.54d	68.0±18.018cd	170.0±19.97a	1.820 bc±0.31112698	1.606 bc±1.18662547	2.1225 b±1.34142648	15-24
80.13 17.42 cd	53.0±7.0 d	101.67±18.77bc	2.4133 b±0.32624122	4.805 a±0.00707107	1.5437 bc±0.59684694	25-34
	51.25±1.707d	127.0±59.62b	0.0 c±	1.6088 bc±0.88671651	2.39 b±	35-and above

Table (2): The level of (ALP enzyme U/l and TSH hormone mIU/L) in first and third trimester of pregnancy.			
Third trimester	First trimester	control	
1.6800 a±0.87332	2.3305 a±1.34827	1.17712 a±0.95224	TSH hormone level
71.09±21.68 b	57.82±13.18b	131.82±47.89a	Level of ALP

Serum electrolytes during pregnancy

Serum sodium during pregnancy

This study found that the level of sodium was lower in elder pregnant than in younger pregnant in first trimester where is in third trimester the level of sodium in elder pregnant was higher than in younger pregnant see table (3).

The results of this study found that the mean concentration of Na in first trimester about 139 mmol/L and about137.818 mmol/L in the third trimester where is in the control group about 137 mmol/L and that the difference between the groups was not significant. See table (4).

The results of other previous research notice that the concentration of sodium in serum was 144 ± 4.2 mmol/L, 140 ±2.3 mmol/L, for healthy non-pregnant, healthy pregnant respectively [23].

Another research found that the serum osmolality and sodium breakdown in pregnancy and may be below non-pregnant reference period and be normal for this physiologic condition.

Sodium in serum was significantly reduce in people with raise TSH concentrations (p <0.01) [17].

Serum potassium during pregnancy.

This study found that the level of potassium was higher in pregnant women at the age of (25-34) than pregnant women at the age of (15-24) in the two trimester,where is it is lower at the age 35 and above when compared with the two other age categories. see table (3).

The results of this study also found that the mean concentration of potassium in the first trimester about 3.9 mmol/L in the first trimester and about 4.5 mmol/L in the third trimester where is in the control group about 4.2 mmol/L and there is no significant difference between the groups. See table (4)

Other previous paper showed that the average plasma potassium was approximately 4.2 ± 1.2 mmol/L, 4.2 ± 0.3 mmol/L, for healthy non-pregnant, healthy pregnant in the mean gestational ages was 25.5 ± 7 weeks for the healthy pregnant women [22].

Another study was agree with this results that found that both sodium and potassium concentration decrease until 28 weeks, after which both rise, potassium significantly so [24].

From the results we found that the young pregnant women and above 35 years suffer from hypokalemia where is the pregnant women at 24-35 suffer from hyperkalemia.from the results of TSH. We found a correlation between hypothyroidism and hyperkalemia. Another study confirm this [25].

Hyperkalaemia was more widespread in the collection with high TSH concentrations (7%) than in those with normal TSH (7 vs. 4%, p <0.01). [17].

The cause of hyperkalaemia in hypothyroidism is the shift of potassium in the cells and increased the excretion of renal potassium [26].

Serum chloride during pregnancy:

This study found that the concentrations of chloride was not significantly decreased in pregnant women at the age of 35 and above and (25-34) in the two trimesters when compared with the women at the age (15-24). see table (3). The results was not agree with previous research that notice that the level of chloride was higher in elder than in younger pregnant (Mohammed, &Inuwa).

The results of this study found that the mean concentration of chloride Cl in the first trimester about105 mmol/L and about 102 mmol/L in the last trimester where is in the control group about 103 mmol/L and there is no significant difference between the groups. See table (4).

Other previous research noticed that the average serum chloride was approximately 99.83 ± 8.09 mmol/L, in first trimester and101.33 ±7.42 mmol/L, in the third trimester where is in non-pregnant approximately100.56±2.4(Mohammed, &Inuwa).

And also another study was agree with this study that showed that the serum chloride levels are unchanged during pregnancy [27].

Another study found that the blood serum osmolality (Na, P, Ca and Mg) decreased from about 287±0.8 to about 278±1.6 mOsm/kg H2O from the fifth week of pregnancy and stayed practically at this concentration till the birth. Hyponatremia was noticed during all the time of pregnancy, in the second and third trimester the low potassium in blood was not noticed. [27].

Hypochloraemia was more prevalence in people with high TSH than in TSH normal people (23 vs 13%, p=0.03) [17].

Table 3: The concentration of chloride, Potasium, Sodium mmol/L in different age categories.			
Cloride level	Potassium level	Sodium level	

Third trimester	First trimester	Control	Third trimester	First trimester	Control	Third trimester	First trimester	Control	Age Categories
105.0± 0.0a	107.60 ±3.85a	101.0 ±1.0a	4.3 ±0.0a	4.1667 ±0.115a	4.66 ±a	134.0± 0.0a	142.0±3.55a	136±0.707a	15-24
102.70 ±6.29a	102.33 ±2.08a	106.0 ±0.0a	4.57 ±1.021a	4.40 ±0.20a	4.1267 ±0.064a	138.20±5.25a	139.0 ±3.56a	134±2.828a	25-34
	101.667±0.577a	102.20 ±3.27a		3.60 ±0.29a	4.20± 0.27a		137.25±3.0 a	138.714±3.73a	35-and above

Table 4:The level of chloride in 1st and 3rd trimester of pregnancy.

Third trimester	First trimester	Control	Serum electrolyte
137.818±3.135 a	139.455±3.908 a	137.455±3.587 a	Sodium
4.545±1.15 a	3.9727 ±0.42a	4.2218 ±0.26a	Potassium
102.909±6.01 a	105.455±3.908 a	103.545±3.012a	Cloride

5. Acknowledgment

The authors would like to thank College of science, Al-Mosul University, Iraq (www.uomosul.edu.iq) for their support of the current work.

References

1. AL-SALEEM IAAA, KAREEM WA. Histopathological Study in Patients with Enlarged Thyroid gland. The Eurasia Proceedings of Science Technology Engineering and Mathematics. 2020;9:23-30. Available from: http://www.epstem.net/en/download/article-file/1174345

2. Lazarus JH. Thyroid disorders associated with pregnancy. Treatments in Endocrinology. 2005;4(1):31-41. https://doi.org/10.2165/00024677-200504010-00004

3. Fantz CR, Dagogo-Jack S, Ladenson JH, Gronowski AM. Thyroid function during pregnancy. Clinical Chemistry. 1999;45(12):2250-8. https://doi.org/10.1093/clinchem/45.12.2250

4. Alemu A, Abebe M, Biadgo B, Terefe B, Baynes HW. Biochemical profiles of pregnant and non-pregnant women attending at the University of Gondar Hospital, Northwest Ethiopia: a comparative cross-sectional study. Ethiopian Journal of Health Sciences. 2018;28(3):331-40. https://doi.org/10.4314/ejhs.v28i3.11

5. Khadilkar S. Thyroid-stimulating hormone values in pregnancy: cutoff controversy continues? : Springer; 2019. p. 389-94.

6. Alexander EK, Pearce EN, Brent GA, Brown RS, Chen H, Dosiou C, Grobman WA, Laurberg P, Lazarus JH, Mandel SJ. 2017 Guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy and the postpartum. Thyroid. 2017;27(3):315-89. https://doi.org/10.1089/thy.2016.0457

7. Stagnaro-Green A, Abalovich M, Alexander E, Azizi F, Mestman J, Negro R, Nixon A, Pearce EN, Soldin OP, Sullivan S. Guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy and postpartum. Thyroid. 2011;21(10):1081-125. https://doi.org/10.1089/thy.2011.0087

8. Calsolaro V, Niccolai F, Pasqualetti G, Tognini S, Magno S, Riccioni T, Bottari M, Caraccio N, Monzani F. Hypothyroidism in the elderly: who should be treated and how? Journal of the Endocrine Society. 2019;3(1):146-58. https://doi.org/10.1210/js.2018-00207

9. Harish K, Nitha R, Harikumar R, Kumar S, Varghese T, Sreedevi N, Bushrath K, Sandesh K, Tony J. Prospective evaluation of abnormal liver function tests in pregnancy. Tropical Gastroenterology: Official Journal of the Digestive Diseases Foundation. 2005;26(4):188-93. Available from: https://europepmc.org/article/med/16737048

10. Cooper DS, KAPLAN MM, RIDGWAY EC, MALOOF F, DANIELS GH. Alkaline phosphatase isoenzyme patterns in hyperthyroidism. Annals of Internal Medicine. 1979;90(2):164-8. https://doi.org/10.7326/0003-4819-90-2-164

11. Tran HA. Biochemical tests in pregnancy. 2005. https://doi.org/10.18773/austprescr.2005.076

12. Modena AB, Fieni S. Amniotic fluid dynamics. Acta bio-medica: Atenei Parmensis. 2004;75:11-3. Available from: https://europepmc.org/article/med/15301282

13. Roy N, Bachu L. Study of Serum IMA and Electrolytes in Patients of Pre-eclampsia in Central India. Available from: https://www.gjihsr.com/GIJHSR_Vol.4_Issue.4_Oct2019/10.pdf

14. Moritz K, Koukoulas I, Albiston A, Wintour EM. Angiotensin II infusion to the midgestation ovine fetus: effects on the fetal kidney. American Journal of Physiology-Regulatory, Integrative and Comparative Physiology. 2000;279(4):R1290-R7. https://doi.org/10.1152/ajpregu.2000.279.4.R1290

15. Mohammed M, Inuwa Y. Determination of serum chloride ion concentration in pregnant women from Minjibir local government area, Kano State Nigeria. Chemsearch Journal. 2012;3(1):19-23. Available from: https://www.ajol.info/index.php/csj/article/view/115717

16. Young SL, Hage ML, Li J. Another case of excessive caffeine and hypokalemia in pregnancy. Obstetrics & Gynecology. 2001;98(5):874. Available from: https://journals.lww.com/greenjournal/Citation/2001/11000/Another_Case_of_Excessive_Caffeine_and_Hypokalemia.30.aspx

17. Schwarz C, Leichtle AB, Arampatzis S, Fiedler GM, Zimmermann H, Exadaktylos AK, Lindner G. Thyroid function and serum electrolytes: does an association really exist? Swiss medical weekly. 2012(37). https://doi.org/10.4414/smw.2012.13669

18. Li J, Liu A, Liu H, Li C, Wang W, Han C, Wang X, Zhang Y, Teng W, Shan Z. Maternal TSH levels at first trimester and subsequent spontaneous miscarriage: a nested case–control study. Endocrine Connections. 2019;8(9):1288. https://doi.org/10.1530%2FEC-19-0316

19. Kim HS, Kim BJ, Oh S, Hwang KR, Jeon HW, Lee SM. Gestational age-specific cut-off values are needed for diagnosis of subclinical hypothyroidism in early pregnancy. Journal of Korean medical science. 2015;30(9):1308-12. https://doi.org/10.3346/jkms.2015.30.9.1308
20. Brown RS, Shalhoub V, Coulter S, Alex S, Joris I, De Vito W, Lian J, Stein GS. Developmental regulation of thyrotropin receptor gene expression in the fetal and neonatal rat thyroid: relation to thyroid morphology and to thyroid-specific gene expression. Endocrinology. 2000;141(1):340-5. https://doi.org/10.1210/endo.141.1.7258
21. Ajala M, Ogunro P, Fasanmade O. Relationship between liver function tests and thyroid hormones in thyroid disorders. The Nigerian Postgraduate Medical Journal. 2013;20(3):188-92. Available from: https://europepmc.org/article/med/24287748
22. Rosenau L, Douay O, Morel B, Lebouvier B, Grosieux P. Serum alkaline phosphatase levels in pregnancy. Journal de Gynecologie, Obstetrique et Biologie de la Reproduction. 1994;23(2):175-9. Available from: https://europepmc.org/article/med/8040575
23. Adewolu O. Serum sodium, potassium, calcium and magnesium in women with pregnancy induced hypertension and preeclampsia in Oredo local Government, Benin Metropolis: A pilot study. African Journal of Medical and Health Sciences. 2013;12(1):1-.
24. Macdonald H, Good W. Changes in plasma sodium, potassium and chloride concentrations in pregnancy and the puerperium, with plasma and serum osmolality. BJOG: An International Journal of Obstetrics & Gynaecology. 1971;78(9):798-803. https://doi.org/10.1111/j.1471-0528.1971.tb00341.x
25. Park CW, Shin YS, Ahn SJ, Kim SY, Choi EJ, Chang YS, Bang BK. Thyroxine treatment induces upregulation of renin-angiotensin-aldosterone system due to decreasing effective plasma volume in patients with primary myxoedema. Nephrology Dialysis Transplantation. 2001;16(9):1799-806. https://doi.org/10.1093/ndt/16.9.1799
26. Tu M-L, Fang Y-W, Leu J-G, Tsai M-H. An atypical presentation of high potassium renal secretion rate in a patient with thyrotoxic periodic paralysis: a case report. BMC nephrology. 2018;19(1):1-5. https://doi.org/10.1186/s12882-018-0971-9
27. Shakhmatova E, Osipova N, Natochin YV. Changes in osmolality and blood serum ion concentrations in pregnancy. Human physiology. 2000;26(1):92-5. https://doi.org/10.1007/BF02760724