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Effect of pregnancy trimesters on some physiological analysis of kidney functions

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Abstract

Many important changes may occur during pregnancy on various organ systems of the body including kidneys. Pregnancy period has significant effects on renal structure and function. The urinary system showed significant physiological and structural changes during pregnancy.

In the present study, a total of 140 blood samples of pregnant women were collected from Al-Zahrra hospital, Iraq- during a period of July 2014 to February 2015.Pregnant women were divided according to their gestational period into three groups, first, second and third trimester group.

Kidney functions including globulin, blood urea, serum creatinine and albumin were measured in blood of these pregnant women.

The results showed highly significant increase in the level of albumin, creatinine and blood urea in first trimester as compared with control group(pregnant women with normal kidney function test) .The results showed highly significant increase in the levels of globulin and protein in second trimester and gradually decline in the third trimester as compared with control group.

In conclusion, many significant physiological changes may occur in kidney functions during pregnancy trimesters.

Introduction

Many significant physiological impact was occur during pregnancy on the various organ systems of the body including the kidney (Levine, 1997;Su etal., 2001).It is therefore, easily conceivable that pregnancy has a significant impact on the renal status of patients with already compromised renal function or structure and similarly renal dysfunction has significant effects on maternal and fetal well-being(Rahmanetal., 2005;Smithetal.,2008)

The urinary system undergoes significant yet predictable physiologic and anatomic changes during normal pregnancy. It is essential understand these changes to appropriately interpret common laboratory to evaluating renal disease in women during

pregnancy (Alper et al., 2007 &Imbasciatietal.,2007).Measurement of kidney functions and proteinuria are the early standard bearers of subclinical pathology with the dramatic hormonal and hemodynamic changes of pregnancy, renal function is altered and these changes must be considered when assessing renal function in pregnancy and in the choice of medications provided through parturition kidney function and filtration of urine are also affected in preeclampsia and recent advances have greatly expanded to understand the pathophysiological mechanisms of this pregnancy-specific renal syndrome (Hou ,1999).

Material and methods

A total of 140 blood samples of pregnant women were collected from AL-Zahrra hospital, Iraq-during the period extended from June 2014 toJanuary2015. Number of pregnant women with normal kidney function tests was 51 (control group).

A Questionnaire sheet was filled out for each pregnant woman studied which included age, period of gestation and medical history of each pregnant woman.

Five ml blood sample were collected from each woman then centrifuged and serum was separated for biochemical analysis. Kidney function were evaluated by estimation of serum albumin according to (Ashley, 2010), serum creatinine and globulin were measured according to the method of (Siestetal .,1988).Blood urea was also carried out according to modified Ureas –Berthotmethod (Baton & Crouch ,1977).

Statistical analyses of the data:

The data was analyzed by student t- test and P value was considered significant when it was $p<0.01$according to **Snedecor and Cochran (1994)** using (SPSS 14,2006).

Results and Discussion

Pregnancy has complex effects on histology and physiology of the renal system and urinary tract, these effects are designed to provide a suitable environment for the growing baby as well as maintaining the health of the mother, the cause of kidney disease can vary from the use of illegal drugs to diabetes and high blood pressure .Kidney disease can lead to high blood pressure, preeclampsia, premature labor, miscarriage, urinary tract infections, worsening of the kidney disease, and kidney failure (**Blowey & Warady, 2007**).

A number of studies suggested that changes in kidney function during pregnancy is mediated by endocrine factor, the secretion of a number of hormones on both adrenal and placental origins markedly increase during gestational period **(Davison etal.,2004 and Fischer , 2007).**

The current study also documented an increase in protein level during the second trimester in some pregnant women compared with control group, this was agree

with **Sharon et al.,2003** who found abnormal levels of proteinuria occurring before 20 weeks gestation underlying intrinsic kidney disease **(Giuseppe D'Amico and Claudio Bazzi ,2003 and Sharon et al.,2003).**

The present study showed an elevation of albumin and blood urea levels in pregnant women tested in first trimester and the serum suddenly drop during second and third trimester and this condition caused by hemodilution of placental tissue, this means that the increased amount of blood in the body of a pregnant woman causes the levels of albumin to drop and a sign of hypoalbuminemia may occur **(Doumas et al, 1971 and Ashley, 2010).**

Moreover, Urea is the main waste product of protein breakdown. It is synthesized in the liver from ammonia which is toxic to the body, but formed as a result of deamination of amino acids **(Cheesbrough, 1998)**. The decrease in serum urea of pregnant women in all trimesters even though not significant might be due to hydration, a rise in glomerular filtration rate (GFR), increased anabolic rate and demand of the developing foetus on the protein of pregnant mothers. A rise in the GFR was thought to account for the increased excretion of urea. As GFR increases without substantial alteration in urea production, due to limited intake of protein, concentration of this molecule decreases in plasma. The alteration in protein metabolism in late pregnancy suggests that amino acids are conserved for tissue synthesis. The sum total of plasma amino acids decline in pregnancy is between 15 -25 %, reflecting enhanced placental uptake and increased anabolic rate. It is a well known fact that the level of urea in urine acutely decreases when dietary protein is restricted, which is an indication of reduced plasma urea **(Bishop, et al. 2013). & (Strasinger & Lorenzo , 2014)**. It appears therefore that as GFR increases in normal pregnancy, in addition to increased anabolic rate, serum concentration of urea decreases.

Results of our investigation also recorded an increase in creatinine level during the first trimester , the result was in agreement with **(Davison etal.,2004 and Rule etal.,2004)** who suggested that during a period of pregnancy, any increased in blood volume and kidney function causes an increase in the amount of creatinine filtered out of the blood and passed into the urine.

Additionally, Creatinine is a muscle metabolite excreted by the kidney in the urine. When formed, creatinine diffuses passively into the blood stream where it is removed by the glomerular filtration action of the kidney, thus the level of creatinine in the bloodstream is reasonably constant **(Newman and Price. 2001)** The progressive significant ($p<0.05$) decrease in the levels of serum creatinine from the 1st to the 3rd trimester of pregnancy may be due to increase in glomerular filtration rate on the GFR.

The GFR increases in normal pregnancy, so the serum concentration of creatinine decreases. It appears that changes in fluid distribution might produce an

increase in GFR and lower plasma creatinine, although these have been found to increase progressively with gestation period; as it was reported that the plasma volume increases during pregnancy, sometimes by as much as 50 % and these changes are accompanied by alteration in the concentration of many plasma constituents including creatinine (**Manjareekaand Nanda, 2013**) which occurs during pregnancy. The increase in glomerular filtration rate (GFR) results in an increase in the clearance rate of urea and creatinine but a decrease in urea and creatinine levels in the serum **(Burtis & Bruns, 2014).** This observation is in agreement with the studies by **(Huy, 2005)** who reported that in pregnancy there is increased cardiac output and renal blood flow and physiological increase in glomerular filtration rate for the clearance of creatinine; so most pregnant patients who have serum creatinine at the upper limit of normal, defined by laboratory tests for non-pregnant individuals, should be viewed with marked suspicion of renal impairment. Serum creatinine is probably the most widely used indirect measure of GFR and one of the means of assessing kidney function. In several renal failures, the plasma concentration of creatinine is raised. Creatinine is freely filtered, so the serum creatinine levels depend on the GFR. The GFR increases in normal pregnancy, so the serum concentration of creatinine decreases. It appears that changes in fluid distribution might produce an increase in GFR and lower plasma creatinine, although these have been found to increase progressively with gestation period; as it was reported that the plasma volume increases during pregnancy, sometimes by as much as 50 % and these changes are accompanied by alteration in the concentration of many plasma constituents including creatinine **(Manjareekaand Nanda 2013).**

Results of the present investigation are in agreement with (Raphael et al , 2013) found that there was a progressive decrease in the levels of serum creatinine and urea, while there was progressive increase in the levels of uric acid across the 3trimesters of pregnancy. There was a significant ($p<0.05$) decrease in the levels of serum creatinine from the 1st to 3rd trimester of pregnancy but the significant ($p<0.05$) decrease in the levels of uric acid is only for 1st and 2ndtrimesters while there was a significant ($p<0.05$) increase in the level of uric acid in the 3rd trimester of pregnancy, when compared with the control. There was a progressive but not significant ($p<0.05$) reduction in the level of serum urea from the 1st to the 3rd trimester of pregnancy.

Conclusion: Many significant abnormal physiological alterations on kidney functions may occur during pregnancy trimesters.

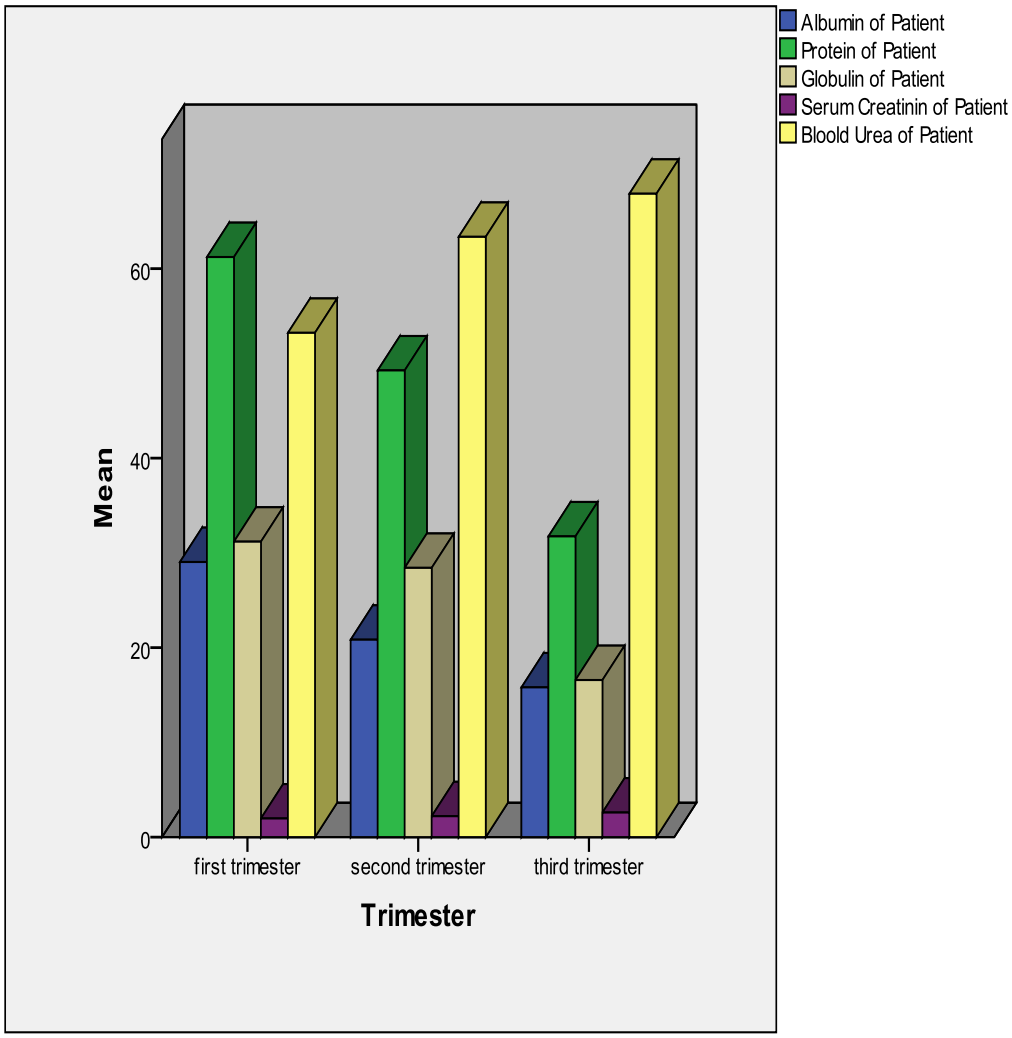

Figure (1): Mean values of kidney function parameters in tested pregnant women distributed according to pregnancy trimesters.

Table (1): Normal values of kidney function tests in normal pregnant woman (Control Group)

Kidney Function Tests	**Normal values of kidney function tests in normal pregnant woman (Control Group)**
Total Serum Albumin	**34 -38 mg /ml**
Total Serum Protein	**50-58 mg /ml**
Total Serum Globulin	**26-30 mg /ml**
Serum creatinine	**0.4-1.2 mg/dl**
Blood Urea Nitrogen	**10-25 mg/dl**

Number of normal pregnant women (Control Group) = 51 woman.

Table (2): Mean and standard deviation of age of pregnant women with abnormal kidneyfunction distributed according to pregnancy trimesters (Mean ± SD).

Trimester	Mean	No.	Standard Deviation
First trimester	23.9259	27	7.45719
Second trimester	25.5161	31	7.74971
Third trimester	23.8387	31	6.85126
Total	24.4494	89	7.31594

$$\mathbf{SE= SD\ x\ \sqrt[-1]{n}}$$

SE=Standard error SD=Standard deviation n = Number of tested pregnant women

Table (3): Mean values of abnormal kidney function parameters measured in pregnant women

Trimester		Albumin of Patient	Protein of Patient	Globulin of Patient	Serum Creatinine of Patient	Blood Urea of Patient
First trimester	Mean	39.0370	61.2222	31.1852	1.9704	53.22
	No.	27	27	27	27	27
	Std. D	5.22186	5.57697	4.64954	.38312	7.186
Second trimester	Mean	20.8387	49.2581	28.4194	2.2097	63.35
	No.	31	31	31	31	31
	Std. D	3.34760	8.74059	5.90353	.33402	6.113
Third trimester	Mean	15.8065	31.7419	16.5806	2.5968	67.90
	No.	31	31	31	31	31
	Std. D	3.39037	6.20198	4.41040	.37902	2.357
Total	Mean	21.5730	46.7865	25.1348	2.2719	61.87
	No.	89	89	89	89	89
	Std. D	6.69275	13.93448	8.10610	.44364	8.151

Table (3): Showed the abnormal kidney function tests measured distributed according to trimesters. It was noticed that there was significant increase in serum albumin in first trimester (39.0370±5.22186) .Serum globulin documented highly significant increase in first trimester (31.1852 ± 4.64954). Total serum protein was significantly elevated in first trimester (61.2222±5.57697). Blood urea nitrogen was significantly higher in the third trimester (67.90 ±2.357) than other trimesters. Significant increase was also noticed in the level of creatinine the third trimester of pregnant women when compared with respective values of control and other trimester's groups.

Table (4): t- Test of the age and kidney function in first trimester of the pregnant women studied compared with control group (pregnant women with normal kidney function tests).

Age &kidney function	t-Value	P-Value	C.S
Age	0.709	0.484	P>0.0.05(NS)
Serum Albumin	9.024	0.000	P<0.001(HS)
Serum Protein	8.690	0.000	P<0.001(HS).
Serum Globulin	0.280	0.782	P>0.0.05(NS)
Serum Creatinine	15.943	0.000	P<0.001(HS)
Blood Urea	37.693	0.000	P<0.001(HS)

Table(4) :Showed highly significant in albumin, protein and blood urea in first trimester of the pregnant women studied compared with control group(pregnant women with normal kidney function test) no significant increase of globulin of the pregnant women studied compared with control group using Student t- test at P<0.01.

Table (5): t- Test of the age and abnormal kidney function in second trimester of the pregnant women studied compared with control group (pregnant women with normal kidney function test)

Age &kidney function	t-Value	P-Value	C.S
Age	0.015	0.988	P>0.0.05(NS)
Serum Albumin	19.879	0.000	P<0.001(HS)
Serum Protein	13.896	0.000	P<0.001(HS)
Serum Globulin	10.247	0.000	P<0.001(HS)
Serum Creatinine	0.190	0.850	P>0.0.05(NS)
Blood Urea	56.645	0.000	P<0.001(HS)

Table(5) :Showed highly significant in level of albumin, protein, globulin and blood urea in second trimester of the pregnant women studied compared with control group(pregnant women with normal kidney function test) using "t" student test at P<0.01there was no significant differences in age and level of Serum Creatinine in this trimester when compared with control group.

Table (6): t- Test of the age and abnormal kidney function in third trimester of the pregnant women studied compared with control group (pregnant women with normal kidney function test).

Age & kidney function test	T	P-Value	C.S
Age	**0.961**	**0.344**	**P>0.005(NS)**
Serum Albumin	**22.396**	**0.000**	**P<0.001(HS)**
Serum Protein	**27.295**	**0.000**	**P<0.001(HS)**
Serum Globulin	**15.234**	**0.000**	**P<0.001(HS)**
Serum Creatinine	**6.895**	**0.000**	**P<0.001(HS)**
Blood Urea	**18.104**	**0.000**	**P<0.001(HS)**

Table (6): showed highly significant all kidney function tests(albumin, protein, globulin, Serum creatinine and blood urea in third trimester of the pregnant women studied compared with control group (Pregnant women with normal kidney function test) using t student test at P<0.01.

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