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Evaluation of amniotic fluid volume among Sudanese diabetic patients in third trimester using ultrasound

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Abstract: Assessment of amniotic fluid volume in diabetic pregnancies is important for maternal and fetus health judgment and pregnancy outcome and for this reason the purpose of this study is relevant using two ultrasonographic methods. The study included 49 Sudanese pregnant women with diabetes mellitus and 20 subjects as control group .The study was conducted at Omdurman Military hospital and Al -Saudi hospital in the period from December 2011 to April 2012. Ultrasound was done by using Mindray 6600, 2200 ultrasound machine fitted with 3.5 MHZ convex probe. Amniotic fluid volume (AFV) was measured by largest pocket and Amniotic fluid index (AFI) .The mean AFI for control group was found to be (16.6±2.4) and the largest pocket was (6.6±0.7),for diabetic sample AFI was (20.3±5.6), largest pocket was (7.4±1.9).T-test showed that AFI was found to be 4.66 at p <0.001, largest pocket was 2.93 at *p*-value 0.005. There is significant difference between AFI measurements and largest pocket for diabetic pregnant ladies compared to the control group.Measurements of AFV using ultrasound compared with type of diabetic and diabetic status is of great value to categorize the relative risk of complications related to diabetes.

Keywords: Diabetes, Amniotic Fluid Volume, Ultrasound

1. Introduction

Measuring amniotic fluid volume is essential in pregnancy assessment. [1]Changes in amniotic fluid volume are associated with adverse pregnancy outcome. The estimation of amniotic fluid volume in the late pregnancy is important for the assessment of fetus health, death, operative delivery.[1]

The amniotic fluid index (AFI) and single deepest pocket are used to detect oligohydramnios in order to predict risk for caesarean delivery. [2] Findings of diminished amniotic fluid index is generally perceived as a sign of placental in sufficiency [3] ,Intra Uterine Growth Retardation as well as renal anomalies in the second trimester.[1]

The most common reasons of Polyhydramnios are increased urine production and maternal diabetes mellitus, fetal macrosomia or other conditions that predispose to a fetal hyperdynamic circulation. [4]

Several studies on AFI has demonstrated serial changes of mean AFI values weekly with the threshold for oligohydromnios and polyhydromnios during pregnancy.[5,6,7]

Normally the amniotic fluid volume increases from approximately 250 mL at 16 weeks to 1000 mL at 34 weeks, declining thereafter to approximately 800 mL at term. The amniotic fluid volume reflects the status of both the mother and the fetus and is altered in many physiological and pathological conditions. [4]

Both pre gestational [8] and gestational diabetes mellitus [9,10] can lead to fetal death, or fetal abnormalities .[11,12,13]

A Varity of approach including biophysical methods, deepest pocket, AFI, 3D, subjective estimation is important and the clinician should consider also AFV as an assessment technique for a given clinical situation taking into account the biology of amniotic fluid formation and regulation through gestation.

Evaluation of amniotic fluid volume using

ultrasonography is of great value [14] in obstetrics care and it has become an integral and important component of pregnancy assessment therefore this study used the ultrasound as an imaging method for this evaluation.

2. Objectives

This study aimed to evaluate the amniotic fluid volume by 2 methods as Amniotic fluid Index (AFI) and single deepest/largest pocket in different diabetes status for Sudanese population using ultrasound so as to evaluate the volume measurements when using these 2 methods as well as to evaluate the amniotic fluid volume in normal and diabetes patients.

3. Materials &Methods

This study was conducted at two of Khartoum hospitals, including AlSaudi hospital, Omdurman Military Hospital. Data were collected in the period from December 2011 to May 2012.Ultrasound devices with a good resolution including Mindray 6600 with TA probe 3.5MHZ and Mindray 2200 –DP with TA probe 3.5 MHZ were used.

The study included 49 diabetic pregnant ladies in third trimester, 20 normal subjects were selected as control group .There is no patient identification or details were published .

Patients were positioned in supine, coupling agent (gel) was applied to lower abdomen; the amniotic volume had been measured using the following methods:

In the Single deepest pool/largest pocket: The size of the deepest, cord-free pool of amniotic fluid is assessed with the ultrasound probe perpendicular to the maternal abdomen .The vertical depth of the largest pool is measured. 1-cm pool was considered acceptable in normal pregnancy.

Amniotic fluid index: Using the maternal umbilicus as a reference point, the abdomen is divided into four quarters. With the ultrasound probe held in the longitudinal axis of the mother and perpendicular to the floor, the largest vertical pool depth in each quadrant is recorded. The sum of these measurements represents the amniotic fluid index (AFI),an AFI < 5 cm is classified as oligohydramnios and an AFI > 25 cm is classified as polyhydramnios.

4. Data Analyses Procedures

The data were analyzed using SPSS program version16 independent T- test, correlation analysis according to Petrie and Watson (2006), simple tables including frequency and percentages, cross tabulations were used for the variables and *p*-value for testing the results significances of the variables was used ,*P* value is significant when < 0.001.

5. Results

Tables from 1 to 5 presented the patients demographic data, age, diabetes status, patient's history, type of diabetes and Ultrasound findings.

Table (1): *Diabetic pregnant patient's age classes ,frequencies and percentage*

Age Classes	Frequency	Percentage%
15-19	6	12.2
20-24	12	24.5
25-29	9	18.4
30-34	12	24.5
35-39	6	12.2
40-44	4	8.2
Total	49	100.0

Table (2): *diabetic status, frequencies and percentage*

Diabetic status	Frequency	Percentage%
Controlled	35	71.4
Un-controlled	14	28.6
Total	49	100.0

Table (3): *history of polyhydramnios and oligohydromonious , frequencies and percentage.*

History of Polyhydramnios	Frequency	Percentage%	History of Oligohydramnios	Frequency	Percentage%
No	41	83.7	No	44	89.8
Yes	8	16.3	Yes	5	10.2
Total	49	100.0	Total	49	100.0

Table (4): *Frequencies and percentage of US findings in diabetic pregnant patients.*

Us findings	Frequency	Percentage
Normal	36	73.5
Polyhydramnios	13	26.5
Total	49	100.0

Table (5): *type of diabetic ,frequencies and percentages*

Types of diabetic	Frequency	Percentage%
Gestational diabetes	12	24.5
Type I	19	38.8
Type II	18	36.7
Total	49	100.0

Table (6): *frequencies and percentage demonstrate of Amniotic fluid Index AFI and largest pocket*

AFI	**Frequency**	**Percentage%**	**Largest pocket(cm)**	**Frequency**	**Percentage %**
5-25	36	73.5	3-8	36	73.5
> 25	13	26.5	> 8	13	26.5
Total	49	100.0	Total	49	100.0

Table (7): *cross tabulation between diabetic status and US findings for diabetic pregnant patients.*

		Us finding		Total
		Normal	**Polyhydramnios**	
Diabetic status	Control	25	10	35
	Uncontrolled	11	3	14
Total		36	13	49
History of Polyhydramnios	No	31	10	41
	Yes	5	3	8
Total		36	13	49
History of Oligohydramnios	No	33	11	44
	Yes	3	2	5
Total		36	13	49

Table (8): *cross tabulation between the type of diabetic and US findings for diabetic pregnant patients.*

		US finding		**Total**
		Normal	**Polyhydramnios**	
Type of Diabetic	Gestational Diabetes	5	7	12
	Type I	15	4	19
	Type II	16	2	18
Total		36	13	49

Table (9): *Cross tabulation between the AFI , Largest pocket and US findings for diabetic pregnant patients.*

		US finding		**Total**
		Normal	**Polyhydramnios**	
AFI	5-25	36	0	36
	> 25	0	13	13
Total		36	13	49
Largest pocket	3-8	36	0	36
	> 8	0	13	13
Total		36	13	49

Table (10): *Demonstrates diabetic status versus type of diabetic of diabetic pregnant patients.*

		Type of diabetic			Total
		Gestational diabetes	**Type I**	**Type II**	
Diabetic status	Controlled	9	13	13	35
	Un-controlled	3	6	5	14
Total		12	19	18	49

Table (11): *Demonstrates of history of oligohydramnios, Polyhydramnios ,AFI, Largest pocket versus types of diabetic*

		Type of diabetic			Total
		Gestation Diabetes	**Type I**	**Type II**	
History of Oligo hydramnios	NO	11	15	18	44
	Yes	1	4	0	5
Total		12	19	18	49
History of Poly hydramnios	NO	10	17	14	41
	Yes	2	2	4	8
Total		12	19	18	49
AFI	5-25	4	15	17	36
	> 25	8	4	1	13
Total		12	19	18	49
Largest pocket	3-8	4	15	17	36
	> 8	8	4	1	13
Total		12	19	18	49

Table (12): *Demonstrates of age classes versus type of diabetic for diabetic pregnant patients.*

		Type of diabetic			**Total**
		Gestational Diabetes	**Type I**	**Type II**	
Age	15-19	3	1	2	6
	20-24	1	7	4	12
	25-29	4	2	3	9
	30-34	3	5	4	12
	35-39	0	2	4	6
	40-44	1	2	1	4
Total		12	19	18	49

Table (13): *demonstrates of significant of test.*

***T*-Test**	**AFI**	**Largest Pocket**
Mean ±SD Control	16.6±2.4	6.6±0.7
Mean ±SD Test	20.3±5.6	7.4±1.9
T	4.66	2.93
P	< 0.001	0.005

6. Discussion

There are many different methods to evaluate and measure the amniotic fluid but all of these methods are difficult, ultrasonic measurements are currently used to evaluate amniotic fluid volume. The ultrasonic methods which are used to measure amniotic fluid volume are Amniotic Fluid Index (AFI)[15] Largest Vertical Pocket (LVP) measurement[16], Two diameter pocket measurement, Largest Transverse Pocket (LTP)maximum transverse[17].

In our study AFI and largest pocket were used to evaluate amniotic fluid volume ,the commonest AFI index ranged between 5-25 acts (73.5%), and who is greater than >25acts (26.5%). The commonest largest pocket in 3-8 was (73.5%), >8 (26.5%) as presented in table (6)

Our study showed that there is a relationship between diabetic status, history of polyhydramnios ,ligohydramnios, type of diabetes, AFI and largest pocket in ultrasound examinations as seen in table(4).

The controlled diabetes resulted in 10 patients affected with poly hydramnios while 25 out of 36 patients were not affected. Uncontrolled diabetes resulted in 11 patients with no poly hydramnios and 3 patients were affected with poly hydramnios .

Table (7) reflects that patient's history of polyhydramnios or oligo hydromonus correlated to ultrasound findings as normal or affected with poly hydramonus were detected in some subjects of the selected sample.

Gestational diabetes is associated with many complications during pregnancy as fetal hyper insulinaemia[19]. Poor maternal glucose control, can lead to this complications as it related to interaction between maternal and fetal circulations, diabetic can increase glucose

concentrations, amino acids and fats, and hyper insulinemia and could affect a number of nutrient transport and metabolic pathways [18].

The diabetes type has been evaluated and was presented in table (8), in patients with G.D; 7 patients out of 12 patients are with poly hydramnios, in type1; 4 out of 19 patients were poly hydramnios, In Type 2; 2 out of 18 is poly hydramnios. In controlled diabetic the G.D were in 9 patients, type1 (13 patients), type2 (13 out of 35 patients).

Uncontrolled diabetic the G.D were in 3 patients, type1 (6 patients), type 2 (5 patients out of 14.) as seen in table (10)

AFI in (5-25ml) normal was (36 patients), none were polyhydramnios, patients >25ml all were polyhydramnios (13 patients).The largest pocket (3-8 ml) normal (36 patients), none were polyhdramnios, patients >8 ml average were polyhdramnios (13 patients) this was presented in table (9)

Patients with history of oligohydramnios or polyhydramnios correlated to diabetic type had also been evaluated in table(11).AFI 5-25ml the largest affected patients in type 2 (17 patients), type1 (15 patients), G.D (4 patients) from 36 patient .>25ml largest in G.D is (8 patients), type1 (4 patients), type2 is one patients from13 patients. In the evaluation using the largest pocket 3-8 ml more affected in type2 is (17 patients), then type1 is (15 patients), then G.D (4 patients) from 36 patients.>8ml largest is G.D (8 patients), type1 (4 patients), type 2 is one patients from 13 patients.

Varma et al ,had discussed the production and regulation of amniotic fluid ;he mentioned that it is a dynamic and complex process involving mainly fetal urine output, fetal swallowing, and fetal lung fluid flow and the amniotic fluid volume is related to fetal weight, but the mechanism of this observation is not understood [19].

Three different theories have been introduced to explain the possible interaction between maternal glycemic status and amniotic fluid volume: maternal hyperglycemia induces fetal hyperglycemia resulting in osmotic dieresis, when the fetal threshold for glucose is exceeded; as glucose equilibrates across the placenta there is an isosmotic movement of fluid towards the fetal compartment with volume expansion and an increase in glomerular filtration rate leading to enhanced fetal urine output production; and decreased fetal swallowing without[20].

Comments affected ages were presented in table(12) as the most affected ages were 20-24 and ages from 30to 34 all were of diabetes type 1.

The mean± SD for control group for AFI was found to be (16.6±2.4) and the largest pocket was (6.6±0.7) .The mean ±SD for diabetic sample for AFI was (20.3±5.6), largest pocket was (7.4±1.9).T-test for the AFI was found to be 4.66 at $p < 0.001$, largest pocket was 2.93p-value 0.005. There is significant correlation between AFI measurements and single largest pocket as seen in table (13)Using the AFI and largest pocket technique is an excellent method in evaluating the amniotic fluid volume [21]. Its validity has been demonstrated by Moore and Cayle[5] as well as other authors[22].

7. Limitations

Our study is hampered by one limitation that the sample size is small.

8. Conclusion

This study deals mainly with diabetic pregnancies to measure AFV. AFV can be obtained significantly by two methods of measurements including AFI and largest pocket.

Ultrasonography (US) has been widely accepted as a screening procedure in measurements of AFV in diabetic pregnancy. It is quick, available, non invasive imaging modality. In addition, no preparation is needed and no presence of ionizing radiation, so it is a safer diagnostic method.

US can define the change of amniotic fluid. As the normal values are known it can detect any changes due to diabetes. Measurements of AFV are an important parameter to show and categorize relative risk of morbidity due to diabetes effects .

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