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The Role of Sonography for Diabetic Pregnancies

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Original Research Article

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Abstract: Gestational diabetes develops during pregnancy (gestation). Like other types of diabetes, gestational diabetes affects cells use sugar (glucose). Gestational diabetes causes high blood sugar that can affect pregnancy and baby's health. This paper was conducted so as to know the importance of ultrasound screening in the diagnosis of diabetic's pregnancy, and also to detect the complications on pregnancy (on second trimester of gestation, the impact on fetal growth, fetal anomalies, fetal miscarriages and intrauterine fetal death). Ultrasound investigation was done using an Ultrasound machine GE Voluson 730 Ultrasound System. All Ultrasound images were B-mode ultrasound performed through the screening. This includes fetal growth, anatomy and physiology effects of Diabetics Disease interactive to the fetal. This study was about the effect of diabetics on fetal anatomy and growth detecting by ultrasound examination. This was a descriptive retrospective and prospective in quantitative an observational. Patients were divided through two sub groups.: Group (A) were 300 Diabetics singleton pregnancy ladies (No diabetic before pregnancy), 168 gestation diabetic (56%).with complications Group (B) included 160 diabetic singleton pregnancy ladies likely with Complications and risk factors. These divided into 108 singleton diabetic pregnancy ladies type (1) were (67.5%) likely with complications. And 52 singleton pregnancy ladies gestation type (2) were (32.5%) without complication. This study was done using data collection sheet. The result of this study revealed that majority of diabetic pregnancy ladies were in the 4th decade (75%). Correlation between Age and affection of diabetes or complications in pregnancy terms is strong significant (*t=-0.492, P= 0.000*). The correlation between pregnancy and diagnostic tools (Blood test with is parameters and Ultrasound scan of fetus in second trimester is strong significant correlation in diagnosis of complications appears on pregnancy terms. Various types of complications during diabetic pregnancy terms were revealed and most of loss of pregnancy showed increased also Amniotic Fluid Ratio (AFI) showed increase with diabetic pregnancy. The detection rate of congenital anomalies for diabetic women was significantly lower than that for the general population within the same institution (30% vs. 73%; $P < 0.01$). The diabetic women were more obese, with an average BMI of 29 kg/m2, vs. 23 kg/m2 in the non- diabetic group (mean body weight 78.5 kg vs. 63 kg). It is well known that obesity is significantly associated with poor ultrasound images17.That means increasing weight and obesity were high prevalence of diabetic pregnancy. Strong Significant Correlation between Diagnosis of Diabetic on pregnancy by AFI measurements and appearance of anomaly during scanning. Ultrasound Scan is more sensitive and specific versus AFI measurements in diagnosing of anomaly using (AFI) ratio. Strong Significant Correlation between Diagnosis of Diabetic on pregnancy by AFI measurements and appearance of anomaly during scanning. Ultrasound Scan is more sensitive and specific versus AFI measurements in diagnosing of anomaly using (AFI) ratio. These results were similar to many previous studies. The present study concluded that Diagnosis of affection of diabetic mellitus in pregnancy based on Lab investigation only is still a challenging problem, combination of Ultrasound screening in second trimester can provide additive valuable information helping in detection of abnormal finding during pregnancy period and improved diagnosis and thus reducing biopsies, the result of the study was in line with previous studies.

Keywords: Pregnancy, Diabietic Mellitus, Ultrasound.

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with the onset or first recognition during pregnancy, with or without remission after the end of pregnancy [1]. India leads the world with the largest number of diabetic subjects, earning the dubious distinction of "*the diabetes capital of the world.*0" [2].

GDM is associated with increased incidence of maternal hypertension, pre-eclampsia, obstetric intervention and risk of developing diabetes mellitus (DM) in later life. The major morbidities associated with infants of diabetic mothers include respiratory distress, growth restrictions, polycythemia, hypoglycemia, congenital malformations, hypocalcemia and hypomagnesemia [5]. Perinatal outcome associated with poor glycemic control in mothers is associated with as high as 42.9% mortality [6]. Appropriate diagnosis and management of GDM can improve maternal and perinatal outcome.

Due to the lack of data in the field of role of sonography in diabetic pregnancy, authors carried this study to conclude this role and enrich the literature.

The current study carried out to assess the performance of routine ultrasound screening in women with pre-existing diabetes (Types 1 and 2) within a tertiary institution. The incidence, type and risk factors for congenital fetal malformations were determined. The detection rate of fetal anomalies for diabetic women will be compared with that for the low-risk population. Factors affecting these detection rates evaluated.

This study aimed to describe diagnostic ultrasound screening in DM gestational patient was very important to assess the status of high risk pregnancy and fetal condition. And to detect the rate of specific problems related to routine ultrasound screening in women with GDM.

MATERIALS AND METHODS

This study was carried out from April 2015 to July 2018 at Sudan University of Science and Technology and Omdurman Maternity Hospital, Omdurman City, Khartoum State, Sudan. A detailed history was obtained from each expectant mother attending the hospital. Out of 1210 women delivered during this period, 460 were categorized as high risk and included in our study according to the inclusion criteria. The exclusion criteria included history of /cardiac/respiratory/hepatic and other medical disease and history of intake of drugs that affect glucose metabolism like corticosteroids. The high-risk women were screened for gestational diabetes with 50 g glucose challenge test (GCT) after 18 weeks, and if GCT was negative, then the test was repeated after 28 weeks of pregnancy. The patients who were having an abnormal GCT were subjected to oral glucose tolerance test (OGTT). All GDM patients were followed up and treated with diet and/or insulin therapy till delivery to know maternal and fetal outcomes.

The study was done on Diabetics singleton pregnancy Patients were clinically diagnosed with Diabetic Miletus. It was a prospective cohort study.

All study samples is (300+ 160) =460 Diabetic pregnancy ladies with singleton gestation. The findings of routine ultrasound screening in the institution between 16 and 24 weeks in the low-risk population, over the same 3-year period were also prospectively collected. During this period, routine maternal serum screening for alpha-fetoprotein (MSAFP screening) was not offered in the institution. Referral scans from other hospitals were excluded from the study

Study's groups were divided into two groups

Group (A) were 300 Diabetic Singleton pregnancy ladies, 168 gestation diabetic (56%) and 132 Type one gestational diabetic (44%) without any symptoms and risk factors.

Group (B) included 160 diabetic singleton pregnancy ladies likely with Complications and risk factors. These divided into 108 singleton pregnancy ladies Type (1) were (67.5%) of diabetic singleton pregnancy ladies and likely with Complications and 52 singleton pregnancy ladies gestation type (2) were (32.5%) with complications and risk factors.

The data of patients obtained from work sheet is used to collect data on more than thirty variables. These variables were divided into main Categories; Data of the patients include name, age, gender, weight. Age, Clinical Presentations, Risk Factors of Maternal characteristic associated with Diabetic Patients, including age, parity, body mass index, previous miscarriage, termination of pregnancy, still birth, previous Cesarean section, type of diabetes (Type 1 or 2), and use of periconception alfolate were retrieved from the medical records for both groups (Gestation diabetic pregnancy group and Diabetic pregnancy types(1,2) group).

Statistical analysis was performed using Statistical Package for Social Science (SPSS Inc., Chicago, IL, USA). A chi-square or Fisher's exact test was used to compare categorical variables, where appropriate. An unpaired Student's *t*-test was used to compare continuous variables with normal distribution. The Mann–Whitney test was used for non-parametric continuous variables. *P*-values of < 0.05 on two-tailed analyses were regarded as statistically significant.

The ultrasound machine used was GE Voluson 730 Ultrasound System. The GE Voluson 730 ultrasound features a state of the art user interface with easy to use on-screen menus, which will allow an operator to conduct scans more efficiently and accurately. With a 15” high resolution monitor, you’ll be able to see ultra-clear results instantly, or they can be archived to CD, MOD or the 40GB hard drive. Among the other features of this model are tissue harmonic imaging, digital beam former with 512 system processing channel technology and four active probe ports.

RESULTS AND DISCUSSION

The following tables and figures presented the results of the study regarding to Ultrasound scan findings, all the patients had a previous Ultrasound scan image which was not conclusive. The sample size in this study was 460 GDM patients who attended Radiology department in Omdurman Maternity Hospital and investigated by Ultrasound for evaluation in second trimester scan or anomaly scan which distribute the participants into two sub groups and detailed results are shown in the tables and figures below.

Table-1: Age Distribution of (Gestation diabetes) Group (A). (This group has no diabetic before pregnancy)

Age Groups	(Gestational diabetes)Group		Total of Gestation diabetes	Percent
	with complications	without complications		
15<25	31	9	40	13.3
26<35	45	54	99	33.0
36<45	53	44	97	32.3
46<55	28	12	40	13.3
56<65	11	13	24	8.0
Total	168	132	300	100.0

Table-2: Age Distribution of Diabetic Pregnancy Types Group (B)

Age Groups	Diabetics pregnancy Types Groups		Total	Percent
	Type 1 diabetes mellitus	Type 2 diabetes mellitus		
15<25	4	6	10	6.25
26<35	10	14	24	15.00
36<45	8	23	31	19.38
46<55	12	29	41	25.63
Above 56	18	36	54	33.75
Total	52	108	160	100.00

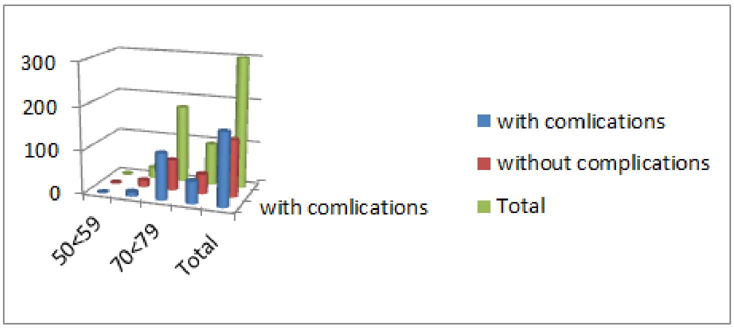

Fig-1: Weight Distribution of (Gestational diabetes) Group (A)

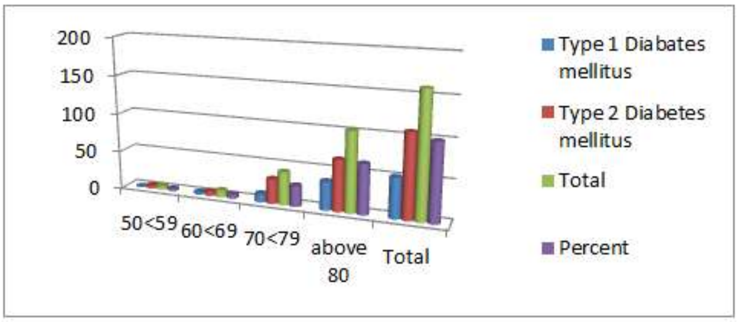

Fig-2: Weight Distribution of Diabetic Pregnancy (Types) Group (B)

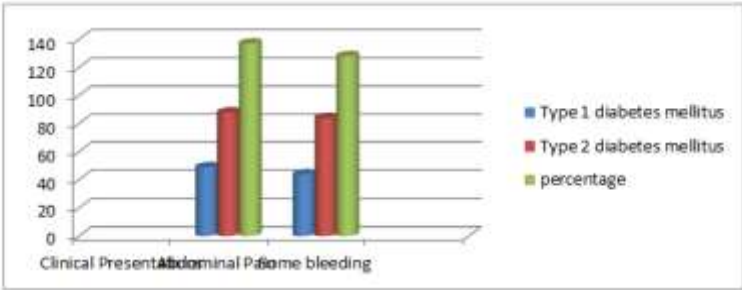

Fig-3: Clinical Presentations Distribution with Diabetic pregnancy Patients Group (B)

Table-3: Hemoglobin A1c Testing Markets level Distribution with Diabetic Pregnancy Patient Group (B)

HBA1c Level	Diabetic pregnancy Group (B)		Total	Percent
	Type 1	Type 2		
GOOD (<7.1%-8%)	10	30	40	25.0
MODERRATE (7.1%-8%)	18	41	59	36.9
BAD (>8%)	24	37	61	38.1
TOTAL	52	108	160	100

DM in pregnancy has severe consequences for perinatal morbidity and mortality. GDM prevalence has been reported variably from 1.4 to 14% worldwide and differently among racial and ethnic groups [11]. Compared to European women, the prevalence of gestational diabetes has increased 11-fold in women from Sudanese subcontinent [1]. Das *et al.*, in their study of 300 women, found 61 with positive screening. Out of them, 12 were diagnosed as gestational diabetes. Among the 12 gestational diabetics, 10 (9.4%) belonged to high-risk group[12]. Bhattacharya *et al.*, Maheshwari *et al.*, and Kummar *et al.* found the incidence of gestational Fetuses of diabetic pregnancies are at increased risk for congenital anomalies, especially when the glycemic control is unsatisfactory during the peri-conceptional period7, 9–12. In these women the risk of having babies with congenital anomalies can reach 20%13,

Regarding to [Table 4.01] and [Figure 4.01], Distribution of Diabetic pregnancy for group (A) were Gestational diabetes individuals. I n group (A) include (168,132) (56%, 44%) respectively. And group (B) (Types diabetic pregnancy) include (52,108) (32.5%, 67.5%). (*n=300, mean= 1.44, S.D= 0.49*) and group B were Types diabetic patients (*n=160, mean= 1.68, S.D= 0.47*). The correlation between age and diagnostic tools (If the blood sugar levels were greater than 140 mg % the screening test was considered positive and those patients were subjected to OGTT to confirm the diagnosis of gestation diabetes. Also we found Increase prevalence of DM in pregnancy with the range in forth decay.

Correlation between Age and affection of diabetes or complications is strong significant (*t=-0.492, P= 0.000*). The correlation between pregnancy and diagnostic tools (Blood test with is parameters and Ultrasound scan of fetus in second trimester is strong significant correlation in diagnosis of complications appears on pregnancy terms. The overall prevalence of congenital anomalies in our diabetic pregnancies was 100/1000. Seventy seven percent of these were classified as major congenital anomalies according to the definition of the Australia Institute of Health and Welfare National Perinatal Statistics Unit. Two thirds of the major congenital anomalies in this cohort involved the spinal/central nervous system and cardiovascular system. It has been shown that the prevalence of major congenital anomalies is associated with periconceptionalHbA1c levels13,14. This is in keeping with the findings from the current study, in which all the pregnancies (7/10) with major congenital anomalies had peri conceptional HbA1c levels >9.5%. It has been shown that improved periconceptional glucose control can reduce the incidence of perinatal mortality and fetal malformations9. Unfortunately, the number of women who sought pre-pregnancy counseling at the specialist center in the current study was extremely low. It would appear that more public health measures and education need to be provided to diabetic women of reproductive age, through the health care workers (general practitioners, endocrinologists and diabetic nurses) caring for them. These women need to be encouraged to attend pre-pregnancy counseling, and to achieve better diabetic control before planning for future pregnancies. Periconceptional folatetherapy may further reduce the risk of neural tube defects15, although Kaplan *et al.*[16] failed to demonstrate an abnormal folate metabolism in pregnant diabetic women.

Currently, routine ultrasound screening can allow the detection and reduction of major congenital anomalies at birth through selective termination of abnormal fetuses. Most ultrasound screening is performed at 18–20 weeks. Detection rates of 40–70% have been reported from tertiarycenters5,6. Most of the published series were on low-risk populations, and the specific detection rate in diabetic pregnancies has not been determined. The current study showed that the detection rate of congenital anomalies for diabetic women was significantly lower than that for the general population within the same institution (30% vs. 73%; $P < 0.01$).

There might be several reasons that account for this difference. Firstly, 30% of the major anomalies in the diabetic group were considered not detectable by current ultrasound technology at the gestational age when the scan was performed. This was higher than in the low-risk group (19%).Nevertheless, after excluding these anomalies, the detection rate was still lower than in the low-risk group (42% vs. 86%; $P = 0.01$). Secondly, the diabetic women were more obese, with an average BMI of 29 kg/m2, vs. 23 kg/m2 in the non-diabeticgroup (mean body weight, 78.5 kg vs. 63 kg). It is well known that obesity is significantly associated with poor ultrasound images17. This is probably a very important factor, as in our study the image quality was considered to be unsatisfactory in 37% of the diabetic women. This group of women had a higher BMI, but unfortunately also had a higher incidence of congenital anomalies (Figure 1). Other reasons that may contribute to the poor image quality include insulin injection given over the lower abdomen, and previous.

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As cardiovascular abnormalities are higher in women with pre-existing diabetes mellitus7,19, another possibility is to offer full fetal echocardiography to these women. Albert *et al.*7 found that the detection rate of congenital anomalies was lower with assessment of the four-chamber view alone, when compared to full fetal echocardiography (33% vs.92%). Fetal echocardiography has been associated with a higher detection rate for congenital cardiac anomalies7, 19, 20. If the image is unsatisfactory, late second-trimester fetal echocardiography may be necessary. Unfortunately, fetal echocardiography for all diabetic pregnancies may not be a feasible option in many units because of resource limitations. Other possibilities such as preliminary nuchal translucency and first-trimester HbA1c screening could be considered. First-trimester nuchal translucency screening has been reported to have sensitivities of up to 80% for detection of fetal chromosomal anomalies at a false-negative rate of 5%21. Increased nuchal translucency thickness (> 3.5 mm) is also associated with an increased risk of cardiac anomalies in chromosomally normal fetuses. A first-trimester nuchal translucency thickness of ≥ 4.5 mm has been reported to be associated with a 15-fold increased risk of congenital cardiac diseases. A nuchal translucency thickness of ≥ 5.5 mm increased the risk by 115-fold22–25. If these findings could be confirmed in diabetic pregnancies, preliminary nuchal translucency screening followed by full fetal echocardiography for women with elevated nuchal translucency thickness may prove to be more cost-effective. It needs to be acknowledged, however, that normal nuchal translucency does not exclude all congenital cardiac anomalies, and the majority of fetuses with congenital cardiac anomalies may not have an increased nuchal translucency thickness26. The same problem is true for HbA1c screening. While a high HbA1c in the first trimester should alert the sonographers to the increased risk of congenital anomalies, the majority of these pregnancies have normal outcomes (84%). First-trimester growth restriction has also been found to be associated with congenital anomalies27. A recent study by Brown and colleagues28 has, however, found that early growth restriction did not appear to be useful clinically in predicting congenital malformations. We similarly could not demonstrate a relationship between small crown–rump length and major congenital anomalies. In this series, obesity appeared to be an additional risk factor for congenital anomalies in diabetic pregnancies. This may not be a coincidental finding, as other researches have also reported the association between maternal obesity and congenital anomalies, after adjusting for maternal diabetes and age29,30. The pathophysiology of this needs to be further investigated. Albert *et al*.7 assessed the role of prenatal screening for congenital anomalies in women with pre-existing diabetes, and found a better detection rate (72%) for congenital anomalies. Combinations of biochemical serum screening, HbA1c, routine morphology scans at 18 weeks, fetal echocardiography at 22 weeks and amniocentesis in selected cases were used. There were, however, several differences between their study and the current one. Only Type 1 diabetic women were included in their series7. Type 1 diabetic women (IDDM) had a lower mean body mass index compared with Type 2 diabetic women in the current series (25.7 kg/m2 vs. 33.9 kg/m2; $P < 0.01$). There was no difference in the incidence of congenital anomalies between Type 1 (5.9%) and Type 2 (11.1%) diabetic pregnancies ($P = 0.3$). Whether this is another confounding factor in the series of Albert *et al.*, apart from the comprehensive sequential screening program used, is debatable7. The cost-effectiveness of such sequential screening also needs to be established. In conclusion, the incidence of congenital anomalies in diabetic pregnancies is higher than that in the general population. The performance of routine ultrasound screening for congenital anomalies in diabetic pregnancies is, however, significantly worse than that for the general population. The most significant reason for such failure appears to be related to maternal habitus and unsatisfactory image quality. Some of these problems could potentially be overcome by newer imaging modalities such as Harmonic imaging and targeted fetal echocardiography. In units with limited resources, first trimester HbA1c and nuchal translucency screening could be considered to select women for full fetal echocardiography. The efficiency and cost-effectiveness of such comprehensive programs need to be established. Since most of the congenital anomalies are related to unsatisfactory diabetic control and obesity, the best public health preventative strategy is still pre-pregnancy counseling, tight periconceptional glycemic control, and periconceptional folate supplementation.

CONCLUSION

Ultrasound screening test on Diabetic Millets is a highly sensitive tool; although the incidence of congenital anomalies is higher in diabetic pregnancies. Unfortunately, the detection rate for fetal anomalies by antenatal ultrasound scan was significantly worse than that for the low-risk population. This is likely to be related to the maternal body habitus and unsatisfactory examinations. This modality should be considered as an adjunct to conventional imaging rather than replacement for histopathological evaluation.

Ultrasound Screening Method in diabetic pregnancy added to routine investigation which leads to improvement in diagnosis and management of diabetic disease in pregnancy.

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