Obstetric ultrasonography as a screening tool for the diagnosis of GDM: Detection of raised AFI and large for gestational age fetus.

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ABSTRACT

Objective: To establish the role of determining increased amniotic fluid index (AFI) and large for gestational age (LGA) fetus on ultrasound for the screening of gestational diabetes mellitus (GDM).
Study Design: Descriptive Observational study.
Place and Duration: Department of Gynaecology and Obstetrics, Pakistan Railway Hospital, Rawalpindi from 1st September 2021 till 28th February 2022.
Methodology: The pregnant women, between 20-30 weeks of gestation, suspected of having excessive AFI or LGA fetuses on routine clinical examination, were advised to have an obstetric ultrasound scan. AFI > 20 cm or LGA on ultrasound (>90th percentile for that gestation) were considered abnormal. These participants were then subjected to 75-gram Oral Glucose Tolerance test (OGTT). Based on OGTT, the sample population was divided into two groups at the post-stratification stage: with and without Gestational Diabetes Mellitus (GDM). Chi-square test was applied to compare the frequency of increased AFI and LGA between patients having GDM or not having GDM.
Results: The study population (n=75) showed the frequency of LGA as 37.3 % and increased AFI as 65.3%. Women with increased AFI were at a significantly greater risk of GDM (65%), as compared to those with normal AFI (27%) with p-value of 0.002. Also, patients having LGA fetuses (60.7%) were at a greater risk of having GDM, as compared to those with normal weight fetuses (34%) with p-value of 0.024.
Conclusion: Women with Increased AFI and LGA fetuses between 20-30 weeks of gestation are at a greater risk to develop GDM. Hence these ultrasound parameters can be used as reliable screening tools for the detection of GDM.
Keywords: Adverse pregnancy outcome, Fetal macrosomia, Gestational diabetes mellitus, Increased Fetal weight, Polyhydramnios

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INTRODUCTION

Gestational diabetes mellitus (GDM) is a common metabolic disorder among pregnant women[1]. Regional variations in the prevalence of GDM have been reported in the world with rates varying from 5.4% in Europe to 11.5% in Asia and 14.5% in mainland China.[2,3] GDM is defined as carbohydrate intolerance leading to hyperglycaemic states with an onset occurring after the initiation of pregnancy.[4] Multiple genetic and environmental factors for GDM are age, obesity, a diabetic family history, sedentary lifestyle etc.[5] Early detection of risk factors may lead to an early intervention for preventing complications and progress of the disease. GDM can lead to be multiple adverse pregnancy outcomes, (such as post-partum haemorrhage, pre-eclampsia, polyhydramnios, increased risk of caesarean section, shoulder of dystocia, congenital malformations, intra-uterine-death etc.[6] Timely diagnosis and treatment is extremely helpful in controlling the disease as well as decreasing adverse pregnancy outcomes.[7] This emphasizes the significance of early detecting GDM in pregnancy. GDM is managed by a combination of lifestyle changes, dietary changes, and therapeutic interventions.
The 75g- Oral Glucose Tolerance Test (OGTT) between 24 and 28 weeks is the recommended gold standard screening test for

GDM. There is a debate as to whether detecting GDM at this stage may still reverse hyperglycaemia in time to prevent complications and adverse pregnancy outcomes. However, WHO has still not reached a consensus as to whether GDM screening may be successfully conducted during the first trimester.[8] Amniotic fluid is a protective liquid that has antibacterial properties in addition to facilitating the maternal and foetal exchange of nutrients. GDM is reported to be strongly associated with amniotic fluid disorders. The Amniotic Fluid Volume (AFV) increases with the increase in gestational age, reaching a peak level of about 800 ml at about 34 weeks. The Amniotic Fluid Index (AFI) is used to assess the level of amniotic fluid volume. Cases with an AFI score of more than 24 cm are termed as polyhydramnios (excessive accumulation of amniotic fluid). Bakhsh et al described a strong connection between GDM and polyhydramnios (p = 0.005). Besides diabetes, other risk factors for polyhydramnios include fetal heart failure, abnormal swelling, and congenital infection. Increased AFI has been linked with multiple problems in the mother and the fetus, including placental abruption, fetal malposition, macrosomia, post-partum hemorrhage etc.[9]

Large for gestational age fetus (LGA) has strong association with GDM in addition to its relationship with increased AFI. A neonatal case is categorized as fetal macrosomia if the birthweight is above 4000 g.[10] In women with GDM, the nutritional supply to the fetus is increased. This results in accelerated fetal growth leading to an increased risk of foetal macrosomia. Hypertriglyceridemia, excess pregnancy weight gain, initial maternal overweight or obesity and inadequate glycaemic control are the predictors for more than average weight at a given gestation. Variation in the prevalence of fetal macrosomia has been reported with an occurrence of up to 28% reported for Croatia. Large for gestational age fetus can be diagnosed based on estimated foetal weight (EFW) which is calculated using fetal parameters such as femur length, head circumference, biparietal diameter and abdominal circumference.[11] We tried to establish the association between large for gestational age fetuses and/or increased volume of amniotic fluid and the probability of having GDM, signifying the importance of these two ultrasound parameters to be used as screening tools. Screening of GDM is very crucial as it has strong link with short- and long-term diabetic complications as well as increased incidence of type 2 diabetes in both mother and fetus. It has been observed in our day-to-day practice, and according to the other studies in the literature, that pregnant patient who were not previously known diabetics and presented with increased volume of amniotic fluid or increased estimated fetal weight, when investigated turned out to be gestational diabetics.[12,13] The purpose of this study was to establish the association of increased volume of amniotic fluid and increased fetal weight with GDM, to suggest their use as screening tools for the detection of GDM.

METHODOLOGY

This descriptive observational study was conducted in Gynae / Obstetrics department of Pakistan Railway Hospital, Rawalpindi from 1st September 2021 till 28th February 2022. Ethical approval was taken from the hospital ethical review committee. The study population comprised of 75-women between 20-30 weeks of gestation, who visited for routine antenatal checkup, and on clinical examination were suspected of having excessive amniotic fluid or large for gestational age fetuses. The AFI and estimated foetal weight was calculated on obstetric ultrasound. AFI of >20 cm or / and increased estimated fetal weight for the given gestation (>90th percentile) on ultrasound was considered as abnormal. The sample population was divided into two groups at the post-stratification stage: with and without GDM. Chi-square test was applied to compare the frequency distribution of increased volume of amniotic fluid and large for gestational age fetus between patients having GDM or not having GDM.

Informed, written consent was taken from all the participants. These women were not previously diagnosed as having gestational diabetes mellitus based on their history, examination, and review of previously available investigations. Pregnant women with a confirmed pregnancy anomaly, multiple pregnancy, pre-pregnancy hypertension or with pregestational diabetes mellitus were not included in the study. The clinical findings of all these women were confirmed by the faculty members of Obstetrics/Gynae unit to minimize study bias. Each ultrasound was performed by the faculty member (with equivalent qualification) from the radiology dept of the hospital to deal with the possible confounding and to improve the reliability of these reports. The 2-hours 75-g oral glucose tolerance test (OGTT) were used for the diagnosis of GDM. The 75-g OGTT tests were performed in the hospital lab.

Data Analysis: Data was analyzed with the help of SPSS version 26.0. Mean and standard deviation were described for quantitative variables such as gestational age (GA), estimated fetal weight and amniotic fluid index. Frequencies and percentages were described for categorical variables such as parity status, serum glucose levels and treatment provided.

The sample population was divided into two groups at the post-stratification stage: with and without GDM. Chi-square test was applied to compare the frequency distribution of increased volume of amniotic fluid and large for gestational age fetuses between patients having GDM or not having GDM. In cases where at least one cell had an expected frequency of five or less, Fisher's exact test was applied. A p-value below 0.05 was considered statistically significant.

RESULTS

The study population (n=75) had a mean age of 29.97 + 4.64 years. Out of total 75 subjects–34 (45.3%) were prim parous (P1), 18 (24%) were P2, 14 (18.7%) were P3, and 9 (12%) women were P4 or above. The mean gestational age of patients at presentation was found to be 27.5+ 2.5 weeks. A-out of 75 patients, 49 (65.4%) had AFI above 20 cm and 28 (37.3%) women had fetus weighing more than average weight at that gestation.

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Table – I: Demographics, Ultrasound Parameters & Treatment Modality of the Study Population (N = 75)

Study Variables		Frequency (%)
Mean Age of patients (years)		29.97 + 4.64
Mean Gestational Age (weeks)		27.5+ 2.5 week
Parity	1	34(45.3%)
	2	18(24%)
	3	14(18.7%)
	Multipara (> 4)	9(12%)
EFW	Normal	47(62.7%)
	Large for given gestation	28(37.3%)
AFI	Normal AFI	26(34.7%)
	>20 cm AFI	49(65.3%)
Treatment	Glucophage	42 (56%)
	Insulin	10 (13.3%)
	Lifestyle Modification	23 (30.6%)

EFW - Estimated Fetal Weight
AFI – Amniotic Fluid Index

As shown in table II, patients with increased AFI (>20 cm) were at a greater risk of having GDM (n = 32, 65%) as compared to those with average AFI (n =7, 27%; p = 0.002). Patients with fetus weighing more than average weight at 20- 30 weeks gestation (n = 17, 60.7%) had a greater risk of developing GDM, in contrast to those having fetus with average weight (n = 16, 34%; p = 0.024).

Table – II: Frequency Distribution of GDM in Patients with Increased AFI (N = 75)

AFI	GDM		Total	p-Value
	Absent	Present		
Normal	19(73%))	7 (27%)	26	0.002
>20 cm	17 (34%)	32(65%)	49	
Total	36	39	75	

AFI – Amniotic Fluid Index
GDM- Gestational Diabetes Mellitus

Table – III:Frequency Distribution of GDM in Patients with LGA Fetus (N= 75)

EFW	GDM		Total	P-Value
	Absent	Present		
Average fetal weight	31(66%)	16 (34%)	47	0.024
Large for given gestation	11 (39.3%)	17 (60.7%)	28	
Total	42	33	75	

EFW - Estimated Fetal Weight
GDM- Gestational Diabetes Mellitus
LGA- Large for Gestational Age

DISCUSSION

Our findings demonstrated that fetuses showing large for gestational age (LGA) parameters and increased amniotic fluid index (AFI) on ultrasound were associated with gestational diabetes mellitus (GDM). Evidence also suggests that during pregnancy, polyhydramnios, and fetal macrosomia (FM) are possible indicators for GDM.[14] The prevalence of LGA fetuses in our study was comparable (37.3%) to European statistics. Globally, the frequency of LGA fetus in mothers GDM is around 10%-30%. Wasim et al reported 20 (26.3%) cases of FM among 76 women with GDM.[19,15] Moreover, infants born to GDM mothers have increased adiposity and have more risk of diabetes and other metabolic disorders in life.[16] Li et al reported interesting findings in a large, prospective cohort study. The findings suggested that accelerated growth of the fetus may be detected even earlier than 20 weeks, thereby indicating that GDM screening should be conducted earlier than the 24-28 weeks recommended time.[17] Italian guidelines already recommend that mothers should be screened for GDM at 16-18 weeks.[18] A study conducted by Mahajan et al in 2021 documented the outcomes in women with pre gestational diabetes and GDM. It was reported that 66 patients had GDM and 34 had pre gestational diabetes. In comparison to our study, FM was reported in only 15% of cases with GDM.[21] Patients having GDM had a greater chance of delivering neonates with greater fetal weight, as compared to those without GDM. Lackovic et al reported a much higher estimated fetal weight for women with GDM, in comparison to women without GDM (p = 0.009).[1] However, Liao et al. reported that higher estimated fetal weight was not associated with the occurrence of GDM.[20] Our study also observed increased Amniotic Fluid Index (AFI) a strong predictor of GDM. However, the frequency of increased AFI (65.3%) in our study was much higher than that of some of the European studies.[11] Lackovic et al also found increased AFI to be strongly associated with GDM.[1] In a cohort of Saudi women, Baksh et al reported a prevalence of 2.8% of polyhydramnios.[9] Wasim et al reported 18 cases of polyhydramnios in 76 patients with GDM.[19]

We have determined that the patients with increased AFI have more chance of GDM, as compared to women with normal AFI. Bicocca et al reported that women with GDM were more prone to develop polyhydramnios as compared to women with normal glycemic control (OR = 2.95; 95% CI 2.62 – 3.32): with a polyhydramnios frequency of 10.5% in patients having GDM.[22]

Women with diabetes in pregnancy have a very high incidence of poor pregnancy outcomes. A pregnant woman with risk factors for GDM must be screened and offered timely intervention. But, if only women with risk factors for GDM are screened, the proportion of missed diagnosis will be very high leading to extraordinary complication rate.[23,24] Our study documented a strong relationship of increased AFI and LGA fetuses with GDM. Considering easy accessibility, frequent and common use of ultrasound; we suggest (after further studies and multicenter trials) the inclusion of these ultrasound parameters as routine screening tools for detection of GDM in second half of pregnancy in undiagnosed cases. Analyzing both LGA fetuses and increased AFI as ultrasound predictors was the main strength of our study. The main limitation of this study was lack of inclusion of other possible variables/ predictors. These include BMI of the mother, pre-eclampsia, periodontal health, AGPAR scores etc. Another limitation is relatively smaller sample size. Future studies should include multiple variables and model a relationship to identify risk factors for GDM on a larger sample.

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CONCLUSION

Increased amniotic fluid and large for gestational age fetuses are strong predictors of gestational diabetes mellitus. Hence these ultrasound parameters could be used as reliable screening tools for the detection of gestational diabetes mellitus

AUTHOR'S CONTRIBUTION

Afzal S: Manuscript drafting, Data compilation and analysis
Sultana S: Conception and design of study, Literature search, Data compilation and analysis.
Shadab W: Manuscript writing, data collection and compilation
Khan MNA: Final critical review of manuscript, Manuscript final reading and approval

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