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Radiology

Ultrasound Study of the Fetus in Diabetic Mothers in Second and Third Trimester

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Original Research Article

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Abstract: Diabetes mellitus (DM) is a common medical complication seen in pregnancy. Maternal hyperglycemia results in fetal hyperinsulinemia causing an increased rate of perinatal mortality, congenital malformations, intrauterine growth restriction (IUGR), macrosomia, shoulder dystocia, metabolic complications and birth trauma. The most common congenital malformations seen include cardiac defects, sacral agenesis, neural tube defects and renal abnormalities. A total of 50 patients were taken up for assessment. These were patients who were pregnant and have diabetes prior to their current pregnancy. The numbers of patients among these who were either type 1 diabetic or type 2 diabetic are given in the details of the findings of the study. These were mostly outpatients who came for their regular antenatal check-ups, though some of them, especially those in the third trimester, were admitted for either monitoring of their glucose levels and / or safe confinement. This study is a prospective study with choosing of the subjects done with the help of a small interview prior to the regular ultrasound examination whether they have a history of diabetes before conception. After choosing the appropriate subjects, they are consequently followed up for evaluation and monitoring of the various fetal parameters noted during the ultrasound examination. Some of the main parameters taken into account include the fetal abdominal circumference, the amniotic fluid index, the width of the placenta and if possible, an anomaly scan of the fetus, keeping in mind the limitations regarding the gestational age of the mother. These findings are appropriately tabulated and compared with the existing literature prevailing for this study.
Keywords: Diabetes mellitus, pregestational diabetes mellitus, fetal parameters.

INTRODUCTION

Maternal diabetes mellitus creates an environment unfavourable for the development of the embryo, placenta and the fetus [1]. Around 3 to 10 % of pregnancies have been estimated to be complicated due to abnormalities in glycemic control and there is a four-fold higher rate of fetal complications in diabetic mothers as compared to non-diabetic mothers [2].

Ultrasound plays an important role in the early identification of complications, recognition and evaluation of any deviation in fetal growth and estimation of fetal weight. In cases of congenital malformations, it helps to provide well-timed options for further management of the pregnancy. Timely and accurate ultrasound evaluation can decrease the fetal morbidity and mortality.

Until the 26^{th} – 28^{th} week of gestation, the growth of the head and femur of the fetus follows a pattern that is similar to that of a normal fetus. After these dates, there is an apparent abnormality in the growth patterns. An abnormal estimated fetal weight (EFW) and an accelerated abdominal circumference (AC) growth were also seen in the third trimester in diabetic mothers. These patterns are essentially different from that of macrosomic fetuses of post-dated non-diabetic patients. Serial ultrasonographic measurements in the third trimester help in selecting the treatment modality and detecting deviant growth in fetal patterns in complicated diabetic pregnancies [1].

AIM AND OBJECTIVES

- To study the various ultrasound imaging features of the fetus in diabetic mothers in second and third trimesters.
- To collect the relevant data pertaining to each of these studies and observes their variations in relation to the sub-section of the population from which the sample size is taken.
- To compare the findings and observations obtained from this study with those prevailing in existing literature, both regional and overall, to derive at a possibility of a region-specific conclusion.

- In the event of a result inclining towards a regional factor, to evaluate the demographics of the sub-population under study for the reason of such an occurrence in difference of the study results compared to existing studies.

MATERIALS AND METHODS

This is a prospective study that explores the patterns of common anomalies and their appearances on ultrasound in diabetic mothers in the second and third trimesters for a better maternal and fetal outcome.

The study was conducted in Sree Balaji Medical College and Hospital, Chromepet, Chennai. The study involves the collection of data from a regular antenatal ultrasound examination of the fetus during the second or third trimester of gestation. A history of overt diabetes mellitus is enquired for, and based on this, and the gestational age being in the second or third trimester, the patient is decided to be inducted into the study. The study was conducted between July 2016 and October 2017 (15 months).

Inclusion Criteria

Pregnant mothers who came to the obstetric outpatient department, and from there referred to an antenatal ultrasound examination, who fulfilled the criteria for the study, that is a history of diabetes mellitus before conception, and the gestation being in the second or third trimester, were inducted into the study.

Exclusion Criteria

Pregnant mothers with the age of gestation being in the first trimester were excluded from the study. Likewise, pregnant mothers with gestational diabetes mellitus, that is the development of diabetes mellitus during the period of their pregnancy, were also not included in the study. As far this study was concerned, the consent was basically implied, as it did not involve any additional procedure or requirement apart from the normal data acquired during the routine ultrasound of the fetus during the patient's regular antenatal visits. However, the patient was informed that her ultrasound data would be collected for the purpose of this research, and upon ensuring that her identification details would not be revealed in any circumstance, their approval for collection of their data was acquired. In those isolated events where some of the mothers were a little apprehensive about this, they were excluded from the study.

Methods

Real-time scanning with a trans-abdominal approach is employed for ultrasound evaluation of the pregnant mother during the second and third trimester of gestation. The current ACR / AIUM guidelines describe the standard ultrasound examination in obstetrics [2]. The ultrasound machine incorporated in this study was Mindray DC – 7. The 'standard fetal anatomic survey', or the 'fetal anomaly assessment' scan, refers to the second trimester scan, and is done between 16 to 22 weeks of gestation.

Statistical Analysis

Data collected for the study include the age of the patient and the type of diabetes mellitus. Gestational age according to LMP is calculated, and fetal biometries measurements are obtained.These include biparietal diameter, head circumference, abdominal circumference and femur length. Amniotic fluid index, gestational age of the fetus according to ultrasound and estimated fetal weight are calculated. From this, fetuses, having an abdominal circumference more than 90^{th} percentile, whose weights cross 90^{th} percentile, which weigh more than or equal to 4000 g (macrosomia), and mothers with polyhydramnios (according to gestational age), are categorized. Patients who underwent the scan at around 20 weeks of gestation had their anomaly study of the fetus, and those that came up positive for fetal anomalies are highlighted.

RESULTS

The ages of the patients varied from the youngest being 22 years to the oldest being 43 years. The mean age of presentation was 31 years. There were 7 patients between 20 and 24 years of age, 12 patients between 25 and 29 years of age, 20 patients between 30 and 34 years of age, 6 patients between 35 and 39 years of age, and 5 patients between 40 and 44 years of age.

The number of patients falling under the category of advanced maternal age (35 years or older) is 11 (Fig-1).

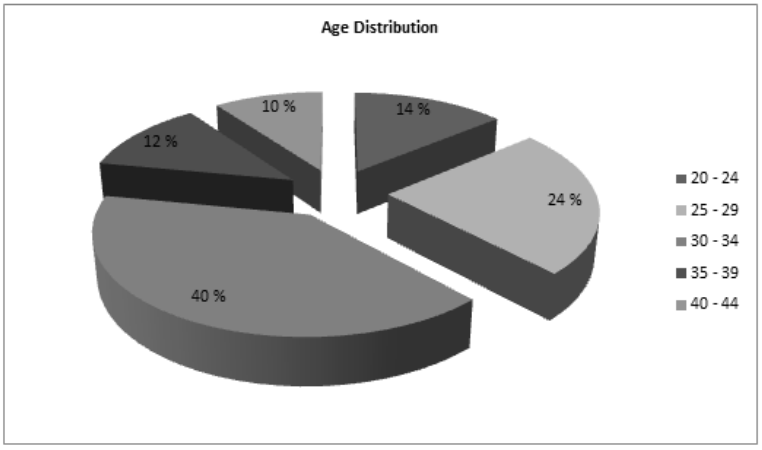

Fig-1: Graphical illustration of incidence of pre-gestational diabetes mellitus in different age groups in the study population

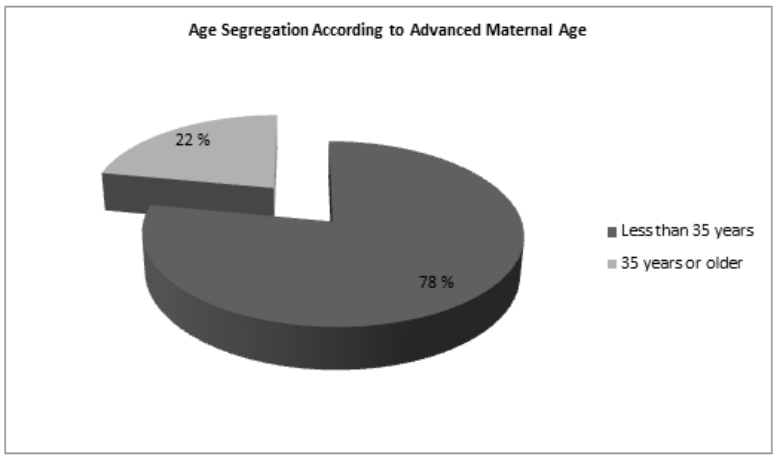

Fig-2: Graphical illustration of the incidence of diabetes mellitus according to advanced maternal age in the study population

Type of Diabetes Mellitus

The question of whether these patients were type 1 or type 2 diabetic could not be reliably assessed, since the most accurate diagnostic standard of type 1 diabetes mellitus is the demonstration of relevant auto-antibodies in the blood investigations of the assessed patients. Since there was a discrepancy in this particular laboratory test, as in the non-availability of this test in the region where this study was carried out, a near relevant history of the patients commencing their diabetic treatment by insulin injections was obtained. Since the management of type 1 diabetes mellitus relies on the administration of insulin injections from the beginning itself, it served as a near-precise pointer towards the particular patient having type 1 diabetes mellitus. Besides, obesity has been observed in patients who present with early-onset type 2 diabetes mellitus, while patients with type 1 diabetes mellitus are generally thinner and at times have a relevant family history, though this particular observation has not been taken into consideration, because of the relative non-reliability, since the obesity factor could depend largely on other demographic, epidemiological and lifestyle factors, needless to mention, other morbidity factors too. Hence, using the history of commencing treatment of the diagnosed diabetes mellitus with insulin injections as a base, 14 patients were found to be type 1 diabetic, while the rest were type 2.

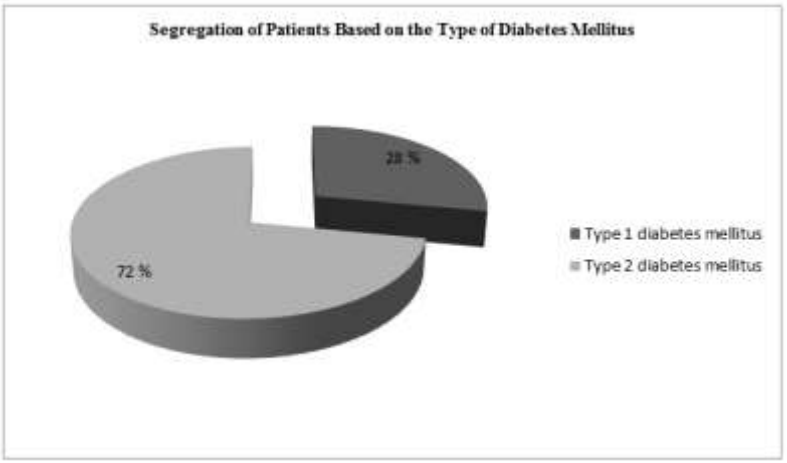

Fig-3: Graphical illustration of the segregation of patients based on the type of diabetes mellitus

As far as medical literature is concerned, patients who are type 1 diabetic, and pregnant, have an increased possibility of their fetuses having intrauterine growth restriction, but several studies have found little or no correlation between the type of diabetes mellitus and the condition under question. In fact, some studies have shown that the fetal growth curves of mothers with type 1 diabetes mellitus follow the pattern of macrosomic or large for gestational age fetuses, though the curves are somewhat different from those of mothers with type 2 diabetes mellitus. Also, HbA1C levels below the stipulated upper limit before conception has been linked to fewer morbidities pertaining to the developing fetus in both categories of mothers having type 1 and type 2 diabetes mellitus, though the HbA1C levels are noted to fluctuate during the period of gestation itself, and such values during pregnancy have not been linked to the increase or decrease in the prevalence of fetal morbidities.

Since the study samples acquired herein had incidentally well-controlled glycemic indices, there was no qualitative difference in the morbidities of the developing fetuses in mothers with type 1 and type 2 diabetes mellitus. None of the mothers with type 1 diabetes mellitus had any evidence of their fetuses undergoing intrauterine growth restriction, and the fetal morbidities, if detected, were qualitatively similar to the ones seen in mothers with type 2 diabetes mellitus. This was confirmed using Doppler studies of the umbilical artery as well as the middle cerebral arteries of the developing fetuses in suspected cases.

Fetal Morbidities

The abdominal circumference of the developing fetus was found to be greater than the 90th percentile in 2 patients, indicating an excess deposition of abdominal fat in the developing fetus, while the effective fetal weight was found to be greater than the 90th percentile in 7 patients. This combined total of 9 patients was diagnosed with large for gestational age (LGA) fetuses. Macrosomia, on the other hand, though comes under the large for gestational age category, is considered separately, because of its definition as the effective fetal weight being 4000 grams or higher. Under this category, 2 patients were classified. Polyhydramnios was diagnosed in 14 patients, while 4 patients were diagnosed with fetal anomalies. The remaining 21 patients had normal fetal biometry measurements.

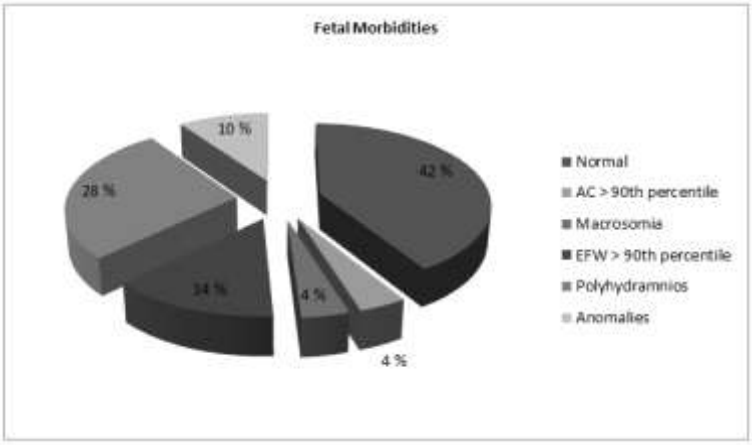

Fig-4: Graphical illustration of the consolidated percentages of the incidence of fetal morbidities in the study population across all the age groups

Fetuses having their abdominal circumference greater than the 90th percentile were found in 2 mothers of the study population, who fell under the category of 35 to 39 years of age, which is an advanced maternal age. Two patients under the age group of 25 to 29 years were diagnosed to have an effective fetal weight of greater than 90th percentile, while four patients were diagnosed for the same under the age group of 30 to 34 years, and one patient under the age group of 35 to 39 years. Macrosomia was found in the developing fetuses of mothers in the 30 to 34 age group, being 2 in number. There was one patient with polyhydramnios in the age group of 20 to 24 years, 3 patients under the age group of 25 to 29 years, 8 patients under the age group of 30 to 34 years, and 2 patients under the age group of 35 to 39 years. There was 1 patient with a fetal anomaly finding in the age group of 20 to 24 years, 1 patient in the age group of 25 to 29 years and 3 patients under the age group of 30 to 34 years.

There were a total of 5 patients who presented with fetal anomalies. One patient, aged 22 years, had a viable fetus with findings of microcephaly in her developing fetus. The falx cerebri was not visualized, and a cystic lesion was picked up in the posterior and central aspect of the cranium. These findings were consistent with holoprosencephaly. In addition to this, there was hyperplasia of the cerebellum, hypertelorism, a short neck, a narrow thorax and a protruding abdomen. There was kyphoscoliosis of the spine, and the sacrum was not visualized, consistent with agenesis of the sacrum. There was a single umbilical artery, along with bilateral club feet and hands. The gestational age was estimated to be around 20 to 21 weeks at the time of the ultrasound scan, and the pregnancy was later terminated in view of the gross congenital anomalies detected. Fetal autopsy confirmed the findings listed during the ultrasound examination. Three other patients, two of whom were 30 years of age, and the other being 32 years of age, who were categorised under the group detected with fetal anomalies had unilateral club feet (congenital talipes equinovarus deformity), on either of the fetal feet. These patients continued their viable pregnancies due to the relatively trivial nature of the anomaly finding. The last patient in the study who was diagnosed to have a fetal anomaly was one who was aged 28 years, and who had a slightly higher amniotic fluid index. The fetal movements were sluggish, though there was cardiac activity. The fetal body wall was found to be edematous, and due to this, the cervical, thoracic and lumbar spinal sections could not be visualized optimally. Both the lungs appeared hypoplastic, with moderate to gross pleural effusion. The heart was grossly compressed and the walls of its chambers appeared thinned, possibly due to the compression, though the actual reason for the thinning of the heart chambers was left to be evaluated by more specialized medical personnel, and whether it was significant for the sustainability of the neonate after delivery. Besides, a minimal pericardial effusion was also noted. The liver of the fetus appeared mildly enlarged with respect to the gestational age. The bowel loops were also grossly hyperechoic. There was minimal ascites too. Both the kidneys were hyperechoic. The urinary bladder was not visualized optimally. During the scan, the upper and lower limbs of the fetus seemed to be in a fixed flexion deformity. Analysing these features of the fetus, a provisional diagnosis of hydrops fetalis was given, suggesting a possibility of multiple pterygium syndromes. The patient was advised for undergoing marker tests for chromosomal abnormalities. Further details on the management of this patient are not available till date.

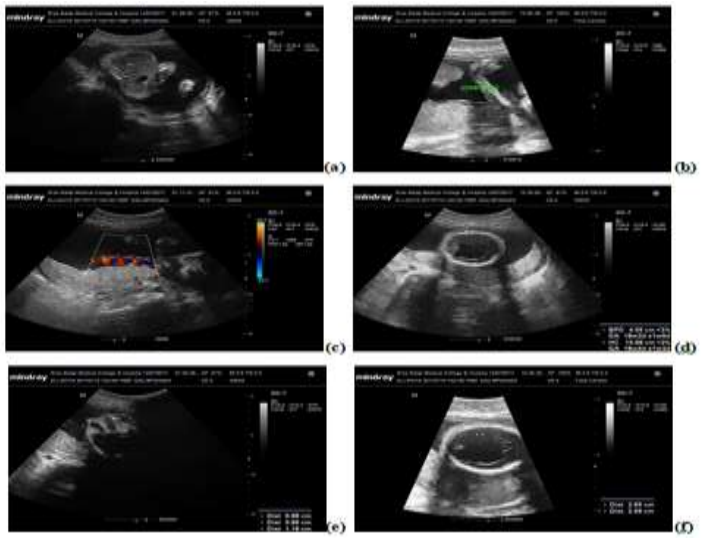

Fig-5: Spectrum of anomalies noted in the developing fetus in a sample patient. (a) Agenesis of the sacrum, (b) Club hand, (c) Single umbilical artery, (d) Holoprosencephaly, (e) Hypertelorism, and (f) Dorsal brain cyst.

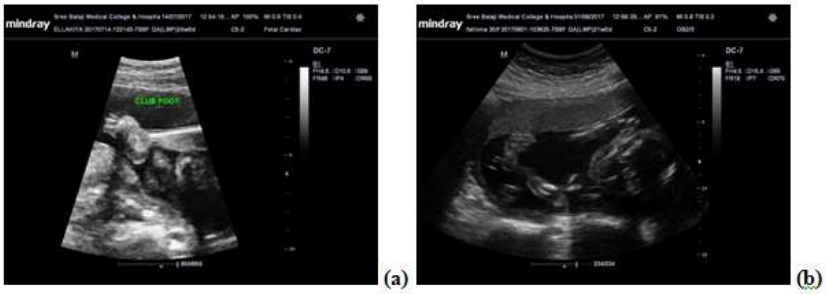

Fig-6 (a) and (b): Club feet seen in the developing fetuses of two sample patients.

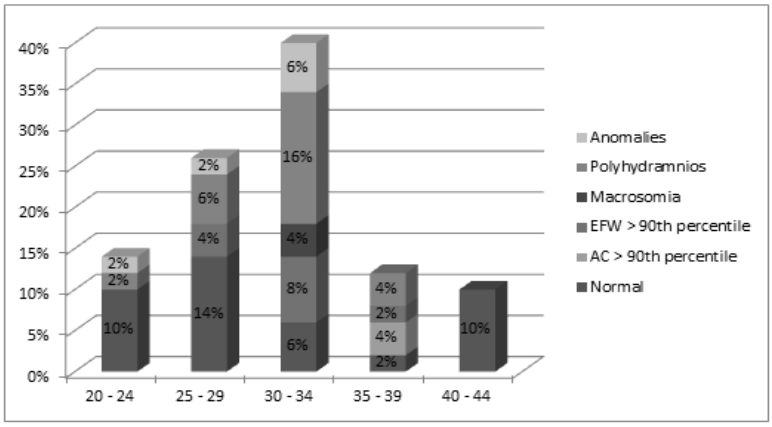

Fig-7: Graphical illustration of the incidence of various fetal morbidities in different age groups in the study population

To put it in a different perspective, a total of 25 patients presented with fetal morbidities below the age of 35 years, and 5 patients presented with the same above 35 years of age (advanced maternal age).

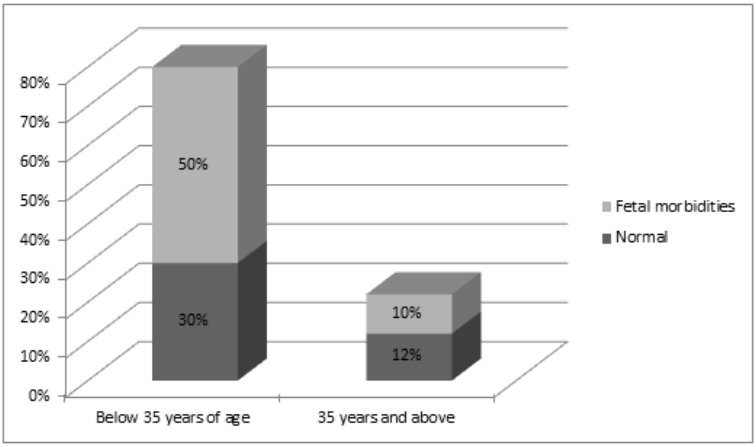

Fig-8: Graphical illustration of the incidence of fetal morbidities in the study population according to advanced maternal age

Below the age of 35 years, 6 patients had an effective fetal weight of greater than the 90th percentile, 2 patients had fetal macrosomia, 12 patients had polyhydramnios and 5 patients had presented with fetal anomalies. As far as patients who were 35 years and above were concerned, 2 of them presented with fetal abdominal circumference greater than the 90th percentile, 1 patient presented with an effective fetal weight greater than the 90th percentile and 2 patients had presented with polyhydramnios.

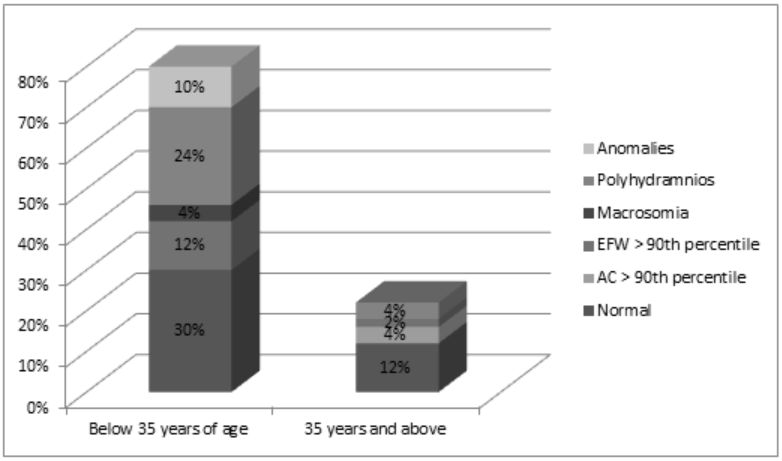

Fig-9: Graphical illustration of the various types of fetal morbidities according to advanced maternal age in the study population

DISCUSSIONS

In 2006, a large prospective study was done using the data obtained from the Nurses' Health Study. This study concluded that there was a racial or ethnic factor involved in the risk of individuals developing type 2 diabetes mellitus. It demonstrated that the highest risk factors were found in Asians, Hispanics and Blacks. The average age of identification of the disease was 66 years [2]. Our study was carried out on a sample size of 50 patients who came for regular antenatal ultrasound check-ups during their second and third trimester of pregnancy, and who have a history of diabetes mellitus before the onset of pregnancy. In other words, our population sample inducted women of the reproductive age group who have a history of diabetes mellitus before the onset of pregnancy; hence the variation in our selection criteria brings down the age group and average age of the population sample drastically.

Population Demographics

The youngest patient in the study population was 22 years of age, while the oldest patient was 43 years. This seemed to be near the normal study population in various studies, or may be a tad lesser.

In a study conducted by Hammoud, de Valk, Biesma and Visser, the mean age of the study population having pre-gestational diabetes mellitus at the time of delivery was 34 years, with a standard deviation of 4.8 years [3]. The mean age of the study population in our case was 31 years. Majority of the patients in the study were less than 35 years of age. This can be attributed to the demographics of the population in the particular region where the study was conducted. The regional characteristics of this sub-section of the population included a comparatively earlier age of marriage which is in line with the various social and traditional systems in this area. This further becomes consistent with the trend that couples usually complete their families mostly before the mother advances into the category of advanced maternal age. As such, most of the cases of pre-gestational diabetes mellitus encountered in the study population would have had their diagnosis at a comparatively younger age than most other studies done in other regions of the world. For example, the National Vital Statistics reports in the United States and studies such as one done by Carolan *et al*. demonstrated that the age at which mothers have their first pregnancies has risen over the years[7,8]. Similarly, Alex Fong *et al*. reported that 33.82 % of their study population was more than 35 years of age.

In a study by McElduff *et al.* the number of mothers who have type 2 diabetes mellitus before pregnancy was higher at 55 %, compared to the mothers who have type 1 diabetes mellitus before conception [9]. But Alex Fong *et al.* reported the opposite of this, that is, the incidence of type 1 diabetic mothers was higher than that of the type 2 diabetic mothers. They attributed this variation to the increased average age of the population sample inducted in the former study, compared to the mean age of around 31 years in their study. As such, in our study, we would have expected the incidence of type 1 diabetes mellitus more, and would have attributed the incidence of type 2 diabetes mellitus in the comparatively much younger population to genetic, family and lifestyle factors, including early-onset obesity. But the patients who fall under the category of type 1 diabetes mellitus in this study are far lesser than expected, compared to other studies like those conducted by Hammoud *et al*. and Alex Fong et al., where the number of type 1 diabetics is usually more than 50 % of the random diabetic samples collected in this age group, probably because of the fallback in the preciseness in which the diagnosis of type 1 diabetes mellitus in this study was carried out, due to non-availability of actual resources required to diagnose the disease [10,11]. Besides, due to lack of standard tests for diagnose of type 1 diabetes mellitus in this region where the study was carried out, the actual patients who are type 1 diabetic are usually started on oral hypoglycemic drugs, except in scenarios where they would have initially presented to the clinician with

diabetic ketoacidosis, which is one of the main characteristics of type 1 diabetes mellitus. Now the type 1 diabetics who were prescribed oral hypoglycemic agents initially would not have responded to the treatment, hence their switching over to insulin injections, which is and remains the standard of treatment for the disease. Since this study takes into consideration the fact that type 1 diabetics are categorised as patients whose initial mode of management involved the use of insulin injections itself, and keeping in mind that this is not always the case as described, there would have been a lot of false negatives in the categorization of diabetes mellitus type 1, leading to the lesser numbers compared to that of type 2 diabetes mellitus in this study. Moreover, the other way round is also possible, that is, a patient who actually had type 2 diabetes mellitus would have been started on oral hypoglycemic drugs, only to find out that after a few months, the diabetes mellitus is still uncontrolled, subsequently shifting the mode of management to insulin injections in such patients. This makes it very cumbersome to precisely differentiate between type 1 and type diabetics in this region where the study was carried out, and hence the description of our results comparing the correlation between the type of diabetes mellitus and the incidence and type of fetal anomalies present in each did not have much scope to be noted, creating a potential for such a study after adequate developments in diagnosis in the near future.

Fetal Morbidities

The main types of fetal morbidities encountered in this study were the fetal abdominal circumference being greater than the 90th percentile, the effective fetal weight being greater than the 90th percentile, macrosomia, polyhydramnios and various fetal anomalies. This can be compared with similar studies done on the assessment of fetal morbidities in both pre-gestational and gestational diabetes mellitus, which include fetal macrosomia, neonatal hypoglycaemia, perinatal mortality, polyhydramnios and an increased risk of caesarean delivery [12-14]. Similarly, in a study done by Landon, known as 'The Hyperglycemia and Adverse Pregnancy Outcomes', it was demonstrated that there was a linear relationship between the maternal glucose levels and adverse outcomes of the corresponding pregnancies [15, 16].

The categories of the abdominal circumference greater than the 90th percentile, the effective fetal weight greater than the 90th percentile and macrosomia are very relative, which altogether have a very similar outcome, that is, a large baby at the time of delivery. Studies conducted on these morbidities have defined them in different ways, and in our case, the definitions are distinct, hence placing them as different categories. For example, the study conducted by Hammoud *et al*. defined macrosomia as birth weight greater than the 90th percentile. In our study, we took up the definition of macrosomia being a quantitative measure, that is, an effective fetal weight of 4000 grams or more, as described by Carol B. Benson and Peter M. Doubilet [17]. Following this, an abdominal circumference greater than the 90th percentile and an effective fetal weight greater than the 90th percentile were placed under the description of large for gestational age (LGA) babies or fetuses, since the increased abdominal circumference eventually leads to an increased effective fetal weight.

In this study, the single largest morbidity found in diabetic mothers was polyhydramnios, followed by large for gestational age fetuses and macrosomia clubbed together, since these entities are not mutually exclusive, and finally anomalies in the developing fetus. This is a little different compared to a study done by Shell Fean Wong *et al*. where the single largest morbidity found in fetuses of diabetic mothers was macrosomia.

O. Langer has postulated that diabetes mellitus in the pregnant mother affects the fetal abdominal circumference more than the biparietal diameter, head circumference or the femur length. Hence, his study suggests that the abdominal circumference plays a vital role in identifying impending macrosomia, or intrauterine growth restriction in other cases. The fetal liver is the organ which gets affected the most depending on the nutritional status of the fetus, and that is the reason the abdominal circumference is taken at this level. In a study by Tamura *et al*. it was estimated that 78 % of the fetuses with abdominal circumference greater than the 90th percentile presented with macrosomia at the time of birth [18]. More recent studies have confirmed the same. In our study, 4 % of the study population had a fetal abdominal circumference greater than the 90th percentile, an indirect indicator towards a large for gestational age fetus or macrosomia.

The effective fetal weight is mainly used to assess whether a normal delivery could be performed with a minimal risk of birth trauma. A large for gestational age (LGA) fetus is defined as one whose effective fetal weight is greater than the 90th percentile. This study documented 14 % of the study population under this category, which is closely related to macrosomia. Macrosomia was found to exist in 4 % of the study population. Though the incidence of 'actual' macrosomia seems less, studies usually incorporate a consolidated incidence of fetal abdominal circumference greater than the 90th percentile, large for gestational age and macrosomic fetuses, which in this case, brings up the consolidated percentage to 22 %. This is because of the linear relationship between an increased fetal abdominal circumference and large for gestational age fetuses to the subsequent development of macrosomia as described. For example, Schaefer-Graf and associates, in their studies, incorporated both large for gestational age and macrosomia as one entity

[2]. This was a similar trend followed by Mulder *et al* [20].

Polyhydramnios, though strictly not a 'fetal' morbidity, is still considered in our study due to its high prevalence in fetuses which are large for gestational age and which have certain anomalies. Polyhydramnios, though can be incidental without any obvious cause, is still linked to conditions which include gastrointestinal tract anomalies (trachea-esophageal fistulas, atresias, diaphragmatic hernias and gastrochisis), musculoskeletal and craniospinal anomalies, diabetes mellitus, hydrops and twin-to-twin transfusion syndrome [21]. In our study, 28 % of the subjects had polyhydramnios, out of which one of them had a fetal congenital anomaly, which was described.

Studies done in the past to evaluate the correlation between maternal hyperglycemia and the prevalence of fetal congenital anomalies came up with positive results [22-24]. These studies are now validated with clinical as well as laboratory data. O. Langer reported that the incidence of fetal anomalies in mothers with pre-gestational mellitus was 6 to 10 %. This corresponds to our study where the incidence of fetal anomalies was 10 % of the study population. Another population-based study demonstrated a strong association between maternal diabetes mellitus and the risk for development of malformations in the central nervous system, cardiovascular system, and structural deformities in the skeletal system, facial features, the urogenital system and the gastrointestinal tract of the developing fetus [25]. Congenital malformations of the heart were found in 40 % of our study population categorised as having fetal anomalies, which is also close to the incidence of 50 % postulated by O. Langer as the proportion of fetal cardiac malformations in diabetic mothers with fetuses having anomalies.

CONCLUSION

Diabetes mellitus is a growing concern in pregnancy. The consequence of an ever-increasing obese population includes an increased risk for an expectant diabetic mother and her developing fetus. Pre-gestational diabetes mellitus has been linked with various adverse pregnancy outcomes which affect the mother, including hypoglycemia, hyperbilirubinemia, pre-eclampsia and pre-term delivery [26-28].

Ultrasound examination is regularly done to assess the age and growth pattern of the fetus. Measurement of the various fetal body parts by ultrasound helps in assessing the size of the fetus. These data are used to assign an appropriate gestational age to the fetus, estimate its weight at the time of the scan, and diagnose any evident growth disturbances. Many studies have demonstrated the increased precision of estimating the expected date of delivery through routine ultrasound screening compared to the LMP of the patient or the physical examination, even when the menstrual history of the patient is regular [29-32].

Some studies have documented an increase in the fetal liver length with a predisposition towards an increased abdominal circumference as early as during the 18th week of gestation, and this became more marked with increase in the duration of the pregnancy [33]. This could serve as an early fetal marker in addition to maternal markers such as glycemic levels in order to commence any relevant medical treatment for the affected mother [33]. Some authors have advocated the use of the abdominal circumference of the fetus between 28 and 33 weeks of gestation to identify its risk for developing macrosomia and use this as a criterion for initiating any relevant pharmacological therapy [35-38].

Fetuses of diabetic mothers have a high risk of sustaining birth trauma. This is due to their increased risk of developing macrosomia, and also because of their tendency for a disproportionately greater body growth compared with that of their heads. This results in injuries such as shoulder dystocia, injury to the brachial plexus and fracture of the clavicle in such fetuses. Hence, when a fetus is diagnosed to be macrosomic, delivery by LSCS is the preferred mode of management.

When the patient is diagnosed to have polyhydramnios, ultrasound assessment of the fetus is advised at closer intervals, to have a better observation of its growth. Mothers with polyhydramnios have difficulty in detecting the fetal movements, and in view of the fact that the possibility of sudden fetal demise in the intrauterine environment is higher than in the general population, a closer observation from the maternal side is also warranted. Preterm delivery is a common consequence of polyhydramnios, which is even more increased when the condition is associated with an anomaly of the fetus [39-42].

The incidence of anomalies in pregnant mothers with diabetes mellitus is found to be slightly higher than in the general population, and depending on the severity of the anomalies detected, whether they are conducive for sustaining life, not only during the intrauterine period, but also post-delivery, keeping in view the quality of life of the neonate, the expenses incurred by the parents to treat the subsequent morbidities of the developing child, and the overall quality of life of the individual, a decision of whether to continue the pregnancy, or a hard decision of forsaking the mal-developing fetus, is made. The 'standard fetal anatomic survey' done between 16 to 22 weeks of gestation also complies with the guidelines under the Medical Termination of Pregnancy Act, if at all the termination of the pregnancy is advised on account of the non-sustainability of the fetus.

On the whole, well-maintained blood glucose levels in pregnant mothers with diabetes mellitus, both during their pre-gestational and gestational period goes a long way in ensuring the proper development of the fetus, and a smooth and uneventful delivery. In addition to this, serial ultrasound measurements spaced at recommended intervals is more predictive in assessing the growth and health of the developing fetus. This will assist in the selection of an appropriate treatment modality in case the fetus shows a deviation in its growth.

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