EFFECTIVENESS OF SCREENING FOR GESTATIONAL DIABETES MELLITUS DURING THIRD TRIMESTER

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ABSTRACT

Diabetes mellitus is the commonest endocrine disorder identified during pregnancy. It can be either pre-existing diabetes mellitus or gestational diabetes mellitus. A descriptive cross-sectional study was conducted among 915 study participants. Singleton pregnant women, who registered before the routine second trimester diabetes screening, were included. If the screening or diagnostic test were negative at 24 – 28weeks, they were screened again by oral glucose challenge test between 34 – 36weeks of gestation. Diagnosis was confirmed with oral glucose tolerance test. Mean age of the study sample was 28.96 years (SD=5.19). Mean values following glucose challenge test was 133.4mg/dl (SD=24.43) at third trimester. Mean blood sugar value following fasting, 2-hour oral Glucose tolerance test was 112.12mg/dl (SD=11.41) and 136.57mg/dl (SD=17.49) respectively. Majority was within the range of 121mg/dl to 140 mg/dl (N=748:81.1%). Mean birth weight was 2.96 kg (SD=361.48). All parameters except incidence of premature rupture of membrane were significantly associated with high blood sugar values following OGTT. Gestational diabetes mellitus in 3rd trimester could be identified as a significant risk factor for high amniotic fluid index (OR=2.449: 95% CI=1.552-3.863), pregnancy induced hypertension (OR=1.729:95 % CI=1.034-2.819), neonatal hypoglycaemia (OR=4.547:95 % CI=1.763-11.732) and admission to special care baby units (OR=3.14:95%CI=1.663-5.930). When the results of glucose challenge test were very high, requirement of confirmatory tests is minimized. Gestational diabetes mellitus in 3rd trimester is a significant risk factor for high amniotic fluid index, pregnancy induced hypertension, neonatal hypoglycaemia and admission to special care baby units. Special attention should be paid on pregnancy induced hypertension with increased blood sugar values. Specific precautions should be taken to treat neonatal hypoglycaemia and other perinatal outcomes when mothers with increased blood sugar levels deliver their babies.

Key words: Gestational diabetes, Glucose tolerance, Prediction

INTRODUCTION

Diabetes mellitus is the commonest endocrine disorder detected during pregnancy. It can be either pre-existing diabetes mellitus or gestational diabetes mellitus. The prevalence of Diabetes mellitus is in a rising trend in South Asian countries during the last couple of decades[1].

Reduction of the insulin sensitivity with enlargement of placental mass could be seen in gestational diabetes mellitus.

22

Usually these pathophysiological changes are observed during the second half of pregnancy. It leads to increased blood glucose levels which can be the reasons for many adverse antenatal and perinatal outcomes. Early identification and application of primary prevention strategies to prevent gestational diabetes mellitus will generate favourable and cost effective management of gestational diabetes mellitus[2]. Gestational diabetes mellitus (GDM) is defined as "glucose intolerance of any degree with onset or first recognition during pregnancy". This definition includes undiagnosed type 1 and 2 diabetes mellitus[3].

Among pregnant women 3% to 10% will be having GDM[3]. Depending on the population, prevalence of GDM may range from 1.0% to 14.0 % of pregnancies[4]. According to statistical data 11.4% of Sri Lankan pregnant women are reported with GDM [5]. In some localities prevalence of GDM is more than 20%[8,13]. According to the available information in the Ministry of Health prevalence of GDM had increased two fold by last eight years[7]. Enhanced economic development of the country was the assumed reason for this observation.

More than 90% of all pregnant women who were diagnosed with diabetes during pregnancy represents GDM. Most of them achieve normal postnatal blood glucose.

But it was identified that the probability of having type II diabetes mellitus within next 5 years is 50% [6]. The risk of having GDM among South Asian are relatively high. So, it is essential to screen all pregnant women for GDM during the first trimester except when they have pre-existing diabetes. This screening procedure should be applied as early as possible, preferably in the first clinic visit. If the first trimester screening is negative, they will be screened again at 24 – 28weeks with oral glucose challenge test (OGCT)[8].

Timely diagnosis of GDM can reduce adverse pregnancy outcomes, including large for gestational age babies, intrauterine deaths, birth trauma, neonatal hypoglycaemia and neonatal respiratory distress syndrome by taking necessary preventive actions. And also, it will reduce the risk of pregnancy induced hypertension [9,10]. For the new-born there is evidence of probable lifetime metabolic integration as a result of exposure to a foetal environment containing excess insulin[11]. These alterations will influence the children to develop metabolic diseases, overweight and diabetes mellitus[12]. Thus GDM is a disorder with great public health significance, improving pregnancy outcomes and risk prediction in women and children for type 2 diabetes in future are main challenges.

Methods

A descriptive cross-sectional study was conducted in a single tertiary care center among 915 study participants. Study population was pregnant women attending antenatal clinic during the research period. Singleton pregnant women, who had first trimester dating scan and registered before the routine second trimester screening, were included in this study. Interviewer administered structured questionnaire and a data extraction sheet were used for data collection. If the screening or diagnostic test were negative at 24 – 28weeks, they were screened again by oral glucose challenge test at 34 – 36weeks of gestation. Diagnosis was confirmed with oral glucose tolerance test. Data was analyzed by SPSS version 22.0. Ethical clearance was obtained.

RESULTS

Age of the participants ranged from 16 years to 42 years. Mean age of the study sample was 28.96 years (SD=5.19). Majority of the participants belonged to the age group of 26-30 years (N=296:32.3). Participant distribution among selected age groups was statistically significant (X^2=199.88: p<0.001). Study sample consisted of both primi gravidae and multiparous participants. Majority was presented with their second pregnancy (N=466:50.5%). Distribution of participants according to the parity was statistically significant (X^2=715.48: p<0.001).

Table 1: Distribution of Blood sugar values of participants

Blood sugar value(mg/dl)	Number(N)	Percentage (%)	
Glucose Challenge Test			
<140	476	52.0	**X^2=216.79**
141-160	325	35.5	**df=2**
≥160	114	12.5	**P<0.001**

Values following glucose challenge test ranged between 93 mg/dl to 207 mg/dl (Mean=133.34: SD=24.43).

Majority of the participants reported less than 140 mg/dl blood sugar values (52.0%: N=475)(Table 1).

Table 2: Association of screening blood sugar values and confirmatory test results

Screening values	OGTT values		
	< 100.8 mg/dl & < 140mg/dl [GDM-]	≥100.8 mg/dl OR ≥ 140mg/dl [GDM+]	
Glucose Challenge Test			
<140mg/dl	468	4	**X^2=707.61**
141-160 mg/dl	298	24	**p<0.001**
≥160 mg/dl	-	113	
Total	**766**	**141**	

Mean blood sugar value following glucose challenge test was 133.3mg/dl (SD=24.43). Majority of the participants recorded blood sugar values less than 140mg/dl (N=472). Participant distribution according to the screening blood sugar values and confirmatory blood sugar values was significantly different from screening procedures (X^2=707.61: p<0.001). All the participants presented with blood sugar values more than 160 mg/dl following glucose challenge test was diagnosed with GDM by OGTT(N=113) (Table 2).

Table 3: Distribution of Antepartum complications and mode of delivery of study participants

Parameter	Number (N)	Percentage (%)	
Amniotic Fluid Index			
High	114	12.5	X^2=515.8
Normal	801	87.5	P<0.001
PIH			
Yes	96	10.5	X^2=571.2
No	819	89.5	P<0.001
PROM			
Yes	62	6.8	X^2=683.8
No	853	93.2	P<0.001
Mode of Delivery			
NVD	759	83.0	X^2=398.7
LSCS/AVD	156	17.0	P<0.001
Total	**915**	**100**	

Significant majority of participants had a normal amniotic fluid index (87.5%: X^2=515.8: p<0.001). Only 10.5% participants were presented with pregnancy induced hypertension (10.5%: X^2=571: p<0.001). Premature rupture of membranes were seen in 62 participants (6.8%: X^2=683.8:p<0.001). Majority (N=759) of participants experienced normal vaginal deliveries compared to other operational assisted deliveries for their childbirth (83.0%:X^2=398.7:p<0.001)(Table 3).

Table 4 : Distribution of perinatal outcomes among study participants

Perinatal outcome	Number(N)	Percentage (%)	
Birth weight(grams)			
<2500	39	4.3	**X^2=1319.9**
2501-3500	823	89.9	**P<0.001**
>3501	53	5.8	
Congenital Deformities	9	1.0	
Neonatal Hypoglycaemia	18	2.0	
SCBU admissions	46	5.0	

Mean birth weight of the participants was 2.96 kg (SD=361.48). Majority of the babies belonged to the range of birth weight between 2.5 kg to 3.5kg (N=823:89.9%). Congenital abnormalities were observed among 9 participants (1.0%), and Neonatal hypoglycaemia was detected among 2.0% of participants (N=18). 46 babies were admitted to SCBU due to pathological perinatal outcomes (N=46:5.0%) (Table 4).

Table 5: Association of maternal and perinatal complications with Gestational Diabetes Mellitus

Complication		GDM+	GDM-	OR	95% CI
AFI	High	32	82	2.449	1.552 – 3.863
	Normal	109	684		
PROM	Yes	12	50	0.751	0.690 – 2.570
	No	129	716		
PIH	Yes	22	74	1.729	1.034 – 2.891
	No	119	692		
LGA	Yes	15	38	0.483	0.234 – 0.821
	No	126	728		
NH	Yes	8	10	4.547	1.763 – 11.730
	No	133	756		
SCBU	Yes	16	30	3.14	1.663 – 5.930
	No	125	736		
Total		**141**	**766**		

AFI=Amniotic Fluid Index; PROM=Premature Rupture of Membranes; PIH=Pregnancy Induced Hypertension; LGA= Large for gestational age; NH= Neonatal Hypoglycaemia; SCBU= Special Care Baby Unit

According to the distribution of perinatal and maternal outcomes which were displayed in above table, all parameters except incidence of premature rupture of membrane were significantly associated with high blood sugar values following OGTT. More than 140 mg/dl following confirmatory oral glucose tolerance test could be identified as a significant risk factor for high Amniotic fluid index (OR=2.449:95%CI=1.552-3.863), pregnancy induced hypertension (OR=1.729:95 % CI=1.034-2.819), neonatal hypoglycaemia (OR=4.547:95 % CI=1.763-11.732) and admission to special care baby units (OR=3.14:95%CI=1.663-5.930). High blood sugar values following OGTT was positively correlated with the incidence of large for gestational age new-borns within the study sample (OR=0.48:95%CI=0.234 – 0.821).

Age above 35 years was identified as a significant risk factor for GDM (OR=4.2:955 CI=2.87-6.21). According to the study findings becoming pregnant with a family history of diabetes mellitus was considered as a risk factor. But it was not in a generally applicable significant level (OR=1.394:95%CI=0.814-2.386). All the patients with a past history of gestational diabetes mellitus have shown increased OGTT values during this pregnancy as well. Increased OGTT values showed significant association with delivering large for gestational age new-borns (OR= 2.28; 95%CI=1.22-4.26). Pregnant women who were detected with a high BMI value during the first trimester showed a significant risk for developing gestational diabetes mellitus (OR=2.17; 95%CI=1.477-3.208).

DISCUSSION

All patients who had very high blood sugar values following glucose challenge test (>160 mg/dl) confirmed as GDM when they were subjected to the OGTT test. While only 7.4% diagnosed as GDM with marginally elevated glucose challenge test in the third trimester. Overall, incidence of GDM in the third trimester is 15.6% in this study population.

When neonatal and maternal complications were assessed on whom GDM was diagnosed in the 3rd trimester, a high amniotic fluid index was shown by significant number of participants. High OGTT values were significantly associated with pregnancy induced hypertension and large for Gestational age babies. For neonatal hypoglycaemia and SCBU admissions, high OGTT values were identified as risk factors. Age above 35 years (OR=4.2:955 CI=2.87-6.21) and high booking BMI were identified as a significant risk factor for GDM in third trimester (OR=2.17; 95%CI=1.477-3.208). All women with a history of GDM have shown increased OGTT values as well.

In the present study mean age of the entire study sample was 28.9 years. Therefore, in relation to age distribution of the study sample it is more deviated towards a higher age group compared to available literature. This could explain the higher incidence of GDM in the present study.

In 2005 Keshwarz et al, stated that percentage of occurring PIH in GDM women is 6.4%. But according to the current study findings, prevalence of PIH among women with high OGTT is as high as 15.4%. According to the same study findings done in 2005, 1.6% of diagnosed GDM women were observed of having PROM. But in the current study 9.3% of women were having PROM. According to the study done by Mallah in Saudi Arabia,

PIH prevalence was 2% among GDM women.

Average birth weight of Sri Lankan newborns is recorded as 2.854kg. Birth weight of 30% of the newborns were above 3.5kg. According to the current study findings mean birth weight was 2.964kg and 6.2% of the newborns had a weight more than 3.5kg. Although the overall birth weight of the study sample was above the general population, percentage of babies with a higher birth weight in the study population was significantly low.

GDM is a condition which, frequently changing new knowledge is applied for its management with many improvements. Usually diabetes mellitus is a medical condition which is contributed by many related factors such as age, sex genetic relationships, psychological status etc. This is directly affected by the life style and the psychological status of the patient. Although the aetiology of GDM is directly related to pregnancy, its severity is modifiable with inherited general contributors.

In the present study, findings which are contradictory to generally accepted established figures were reported. During this study recorded percentage of newborns with high birth weight among GDM women was less than the expected value. Reported PIH patient percentage was relatively high. Therefore there is a need for a larger study design inclusive of additional outcome measures. The study sample should represent the pregnant mothers of the whole country and it should contain stratification according to the age and parity of the mothers. The gestational age of blood sugar measurement should be clearly predetermined and a higher reliability can be achieved by performing separate analysis of blood sugar values collected at different gestational ages.

If there was a chance of identifying these participants during the pre-pregnancy period, there is a possibility of recording anthropometric measurements and even baseline blood sugar values. With these information, prediction of GDM will be unexpected, but much important findings could be generated. And on the other hand careful observation should be done during the follow up period, as there is a higher possibility of missing their follow up.

To avoid this attrition bias, it is preferable to use a methodology such as intention to treat analysis. Guidelines to diagnose GDM and screen for GDM are frequently modified. Therefore it is beneficial to study the outcome variables with several cut off levels. Most suitable method is to conduct a matched control analysis by using a comparative study design. This will permit room to conduct a further analysis on the abnormal findings experienced during the present study.

There are lot of on-going research regarding GDM as well as pre-existing diabetes mellitus. Using these findings the existing management and prevention guidelines should be always updated. Findings of the present study can be used for this purpose.

In any screening method false negatives and false positives should be expected. Gold standard test is the one which is has minimum false results. In GDM, OGTT is the widely accepted gold standard test. But in this case OGTT is not a popular diagnostic test due to several reasons. Keeping fasting, difficulty in drinking concentrated glucose solutions, collecting blood samples in relatively shorter frequencies are among the reasons which create reduce compliance for OGTT in pregnant mothers. If a more convenient screening test can be used for the necessary prediction it will be useful and also be more cost effective.

According to the present study findings all of those who had more than 160mg/dl for glucose challenging test findings, their OGTT value confirmed the diagnosis of GDM. So according to that, if there is a value more than 160mg/dl for glucose challenging test, there is no need of doing OGTT as a confirmatory test. During pregnancy period food preferences can be changed and also there is a marked difficulty in keeping fasting. So to establish more feasible criteria, applying the gold standard test is more important and to achieve that present study findings creates a good assistance.

CONCLUSIONS AND RECOMMENDATIONS

When the results of glucose challenge test were very high, requirement of confirmatory tests is minimized. Gestational diabetes mellitus in 3rd trimester is a significant risk factor for high amniotic fluid index, pregnancy induced hypertension, neonatal hypoglycaemia and admission to special care baby units. Special attention should be paid on pregnancy induced hypertension during the antenatal management of mothers with increased blood sugar values. Specific precautions should be taken to treat neonatal hypoglycaemia and other perinatal outcomes when mothers with increased blood sugar levels deliver their babies.

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