UNIVERSAL SCREENING WITH GLUCOSE CHALLENGE TEST IN DETECTION OF GESTATIONAL DIABETES

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ABSTRACT

Objective: To compare efficiency of glucose challenge test with oral glucose tolerance test for detection of gestational diabetes mellitus (GDM).

Methods: This observational cross sectional study was conducted in The Department of Obstetrics and Gynaecology, Sharif Medical and Dental College / Sharif Medical City Hospital, from December 2012 to June, 2013. 1000 consecutive pregnant ladies were included during this period between the gestational age group of 26 to 30 weeks by using convenient sampling technique after analysis of risk factors. All women undergo glucose challenge test (GCT) and glucose tolerance test (GTT). Results of GCT were compared with glucose tolerance test as gold standard.

Results: Out of 1000 pregnant ladies, glucose challenge test screened 450 patients with positive results, and 550 patients with negative results. Out of 450 screened positive patients, oral glucose tolerance test (OGTT) detected 400 patients with true positive result and 50 patients with false positive results. Out of 550 screened negative patients of GCT, oral GTT detected 510 patients with true negative and forty patients with false negative results. So the sensitivity of GCT was 90.90%. Prevalence of gestational diabetes was 44%.

Conclusion: Universal screening with glucose challenge test is a reliable cost effective and excellent screening test for gestational diabetes in low resource setting.

Key Words: Gestational diabetes, glucose challenge test (GCT), oral glucose tolerance test (OGTT).

INTRODUCTION

Gestational diabetes mellitus (GDM) affects 2 – 5% of all pregnancies and is a significant risk for feto-maternal morbidity, perinatal mortality and development of type II diabetes.[1] Screening of gestational diabetes significantly reduces this risk. Being associated with number of complications, WHO and ADA recommend universal screening of all pregnant women for gestational diabetes at 26 – 32 weeks by 50 gram glucose challenge test, but ideal screening method always remain controversial. Numbers of other screening tests are also available including glycosuria, random blood sugar levels, fasting blood glucose level, timed sugar testing, glycoslated haemoglobin, but they are less sensitive in detection of diabetes.[2] Finally glucose tolerance test (GTT) was used as confirmatory test for the diagnosis of diabetes. But the number of complexities including prior appointment, cost, prolong waiting, ingestion of glucose, burden on busy lab make it inconvenient for patient. So there is always a need for screening test which detect maximum number of patients and thus less number will undergo glucose tolerance test. The major issues in screening include universal versus selective screening of high risk group. Advocates of universal screening argue that selective screening missed approximately one half of women with gestational diabetes, while universal screening appears to be more cost effective, facilitate earlier diagnosis and improve pregnancy outcome. The second issue is defining threshold of 50 gm glucose challenge test. The sensitivity of the test will be improved from 80 to 90% by doing the test in fasting state and lowering threshold to 130 mg/dl rather 140 mg/dl (7.8 mmol/l). In major studies whatever threshold will be used sensitivity of 79% and specificity of 83% has been reported when compared with other screening tests.[3] Improving sensitivity to 100% at 130 mg/dl may require GTT in 25% of women for detection of gestational diabetes while at 140 mg/dl only 15% of women will require GTT. This high sensitivity and low specificity of 130 mg/dl will justify use of 140 mg/dl threshold in screening of gestational diabetes rather 130 mg/dl. GCT will prove to be more cost effective and less time consuming test and subject a minimum number of the women to the diagnostic oral glucose tolerance test.[5] Pakistan being Asian country considered ethnic risk factor for gestational diabetes but exact prevalence of gestational diabetes in our population is not known and in most of studies it is around 3.2% for GDM and 1.9% for impaired glucose tolerance.[5] This study aims at finding the prevalence of gestational diabetes and sensitivity of GCT as screening test for detection of gestational dia-

betes in our hospital population so that universal screening should be applied rather than selective screening.

MATERIALS AND METHODS

This cross sectional study was conducted at Department of Obstetrics and Gynaecology, Sharif Medical and Dental College / Sharif Medical City Hospital, from December 2012 to June, 2013.

One thousand consecutive pregnant women attending antenatal clinic were included irrespective of any risk factor between 26 – 30 weeks of duration of gestation. The women excluded from the study were known diabetics and women suffering from any other associated medical disorders and presenting before 26 weeks. Patients were considered risk factor positive if any of the following is present:

Age > 35 years.
Previous macrosomic baby (4 kg or more birth weight.
History of gestational diabetes.
Recurrent miscarriages.
Obese or pre-pregnancy weight more than 80 kg.
History of diabetes in first degree relative.
Previous baby with congenital abnormality.
Previous unexplained still birth / neonatal death.

Detail maternal history was taken including LMP for confirmation of gestational age, past history of diabetes and any medical disorder and other variables that were asked include patient age, parity, weight of pregnant mother, family history of diabetes in first degree relatives, presence of polyhydramnios and glycosuria in current pregnancy, history of congenital abnormal baby, intrauterine fetal demise and early neonatal deaths in previous pregnancies. Physical examination was performed including height, weight, and blood pressure. Relevant investigations were done including urine for glycosuria, ultrasound for confirmation of gestational age and amniotic fluid assessment for presence of polyhydramnios. After informed consent patients were enrolled for study, a load of 50 gram glucose without dietary preparation was given to women. Plasma glucose was measured after one hour. Patients were labeled as screened positive if blood sugar levels were > 140 mg/dl (7.8 mmol/l) and screened negative if < 140 mg/dl. After one week all patients underwent, 2 hour 75 gm glucose load after an 8 hour fasting as diagnostic test. Fasting blood venous samples were taken after cleansing the site by using 70% alcohol. Then the woman was given 75 gm glucose dissolved in 200 ml of water and two hour venous blood sample were taken. The results were interpreted according to WHO criteria (operational definition) and explained to mothers and their implications. The women diagnosed to have gestational diabetes were started insulin therapy and dietary advice was given. They were followed in our antenatal clinic and encouraged to deliver in our hospital. Sensitivity, specificity, predictive values were calculated of GCT by comparing with oral glucose tolerance test (GTT) as gold standard. All data was entered in SPSS 17 and descriptive statistics were calculated. Mean calculated for maternal age and gestational age, and 95% confidence intervals were calculated, p-value < .05 considered as statistically significant. ODDs ratio and relative risk calculated for risk factor association. Open Epi was used to determine the validation analysis of screening test with gold standard.

OPERATIONAL DEFINATIONS
Interpretation of Glucose Challenge Test
Normal Screen: Less than 140 mg/dl (7.8 mmol/l).
Abnormal screen: > 140 mg/dl.

Interpretation of OGTT
Normal: Fasting < 7.8 mmol/l.
Impaired Glucose Tolerance: 140 to 200 mg/dl (7.8 to 11.1 mmol/l.
Diabetes: Over 200 mg/dl (11.1 mmol/l.

RESULTS

In this study out of 1000 patients, 45% were within the age group of 20 – 25 years with mean age group of 27.833 ± 5.25 years. Four hundred and seventy patients were with parity of G_{3-5} and among them 80% were GCT positive. Higher maternal weight is considered a risk factor for gestational diabetes. In this study 65% pregnant ladies were weighing more than > 80 kg and among them 88.89% showed GCT positive result. The mean duration of gestation for diagnosis of gestational diabetes was 28 ± 1.58 weeks.

The analysis of risk factor for gestational diabetes when studied it was found that 46% of patients had family history of diabetes in first degree relative, out of which 77.78% were GCT positive (p < .000, OR 15.44, RR 4.39). regarding association of polyhydramnios in pregnancy, out of 45% pregnant ladies with GCT positive fifty patients had polyhydramnios, while 20 patient of GCT negative had polyhydramnios (p < .000, OR 3.312, RR 1.66) (Table 1).

After exclusion of primigravidas in this study, out of 430 GCT positive patients, 30 patients (6.98%), had previous history of congenital anomalies (p < .009, OR 2.55, RR 1.33) and 40 patients (9.30%) had previous history of early neonatal deaths and intrauterine fetal demise (p < .000 OR 3.48, RR 1.49). Regarding association of glycosuria in pregnancy 270 patients had history of glycosuria out of which 46.67% were GCT positive (p .000, OR 7.14, RR 2.36) (Table 1).

GCT screened 450 patients with positive result and 550 patients were screened negative (Table 2). Out of 450 patients with positive GCT, OGTT detected 40% patients with true positive and 50 patients with false positive results. Out of 550 GCT negative, OGTT screened 510 patients with true negative and 40 patients with false negative. So by performing OGTT 440 patie-

Table 1: *Risk assessment in screened population.*

Variable	GCT Negative (N = 550)	GCT Positive (N = 450)	P-value	Odd Ratios	Relative Risk
Weight					
< 80 kg	300 (54.55%)	50 (11.11%)	.000	0.104	0.232
> 80 kg	250 (45.45%)	400 (88.89%)			
Glycosuria Association					
Present	60 (10.91%)	210 (46.67%)	.000	7.14	2.36
Absent	490 (89.09%)	240 (53.33%)			
Polyhydramnios Association					
Present	20 (3.64%)	50 (11.11%)	.000	3.312	1.66
Absent	530 (96.36%)	400 (88.89%)			
Family History of Diabetes					
Present	106 (19.27%)	354 (77.7%)	.000	15.44	4.39
Absent	444 (21.33%)	96 (21.33%)			
Previous History of Congenital Anomalies (N = 70)					
Present	10 (2.8%)	30 (6.97%)	.009	2.55	1.388
Absent	340 (97.12%)	400 (93.02%)			
Previous H/o IUD (N = 780)					
Present	10 (2.8%)	40 (9.30%)	.000	3.48	1.497
Absent	340 (97.12%)	390 (90.69%)			
Previous H/o Neonatal Death					
Present	10 (2.8%)	40 (9.30%)	.000	3.48	1.497
Absent	340 (97.12%)	390 (90.69%)			

Table 2: *GCT Versus OGTT (N = 1000).*

	GDM Present	GDM Absent	Total
Positive	400	50	450
Negative	40	510	550
Total	440	560	1000

Table 3: *Validation Analysis of GCT as Screening Test for Gestational Diabetes using OGTT as Gold Standard (N = 1000).*

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
95% CI	90.90%	91.07%	88.88%	92.72%	91%
	87.83% - 93.43%	88.40% - 93.30%	85.61% - 91.64%	90.23% - 94.75%	89.07 – 92.62

nts were diagnosed as gestational diabetics, while 56% had no diabetes.

Sensitivity of GCT as screening test was 90.90% (95% CI 87.83%−93.43%) and specificity turned out to be 91.07% (95% CI 88.40% – 93.30%). Positive predictive value of GCT was 88.88% (95% CI 85.61% – 91.64%) and negative predictive value was 92.72% (95% CI 90.23% - 94.75%). Diagnostic accuracy was found to be 91% (95% CI 89.07 – 92.62) (p-value .0001) with an Odd ratio of 102 (95%) CI 25.7–404.8) and relative risk of 12.22 (95% CI 53.33 – 32.54) (Table 3).

DISCUSSION

Gestational diabetes has been identified as distinct entity deserving increased recognition, management and research. In Pakistan where prevalence of gestational diabetes mellitus is largely undetermined there is good reason to believe that it may be high. The concept of screening of GDM du-ring antennal period helps to reduce the prevalence of disease in high risk group.[6]

In this study percentage of GCT positive patients were higher in advanced maternal age group with mean age group of 27.833±5.25 years. Out of 180 patients in age group of 31 – 35 years, 120 patients (66.67%) GCT positive. A study conducted in china by LU et al, revealed that GCT positive rate was higher in advance maternal age.[7] Another study by Ling reported 30.09% screen positive in age group of 25 – 29 years however in this study it was 35.55%.[8]

In this study 45% pregnant ladies were diagnosed as GCT positive, out of which 44% were diagnosed as having gestational diabetes. Di Cianni et al in 2003 reported that 1389 ladies when screened GCT was positive in 35.2% and 23.2% were having gestational diabetes.[9] The high rate in this study might be a reason that most of the patients had risk factors for gestational diabetes. To have better feto-maternal outcome

universal screening should be offered to all our pregnant ladies considering such high prevalence in this study population.

The strength of the study is that all our patients underwent both test, thus we did not discriminate patients who had a negative screening test by excluding them from undergoing the diagnostic OGTT. They acted as their own control and the result is a true reflection of actual situation without sampling bias. Our study is also population based and represented actual situation in the community.

A study conducted by Bancrofft concluded that maximum number of GCT positive patients were diagnosed at 28 weeks (31.8%) however in this study maximum number of GCT positive patients (44.44%) were found at 30 weeks of gestation reflecting the fact that the risk of gestational diabetes increase with increasing duration of gestation.[10]

The risk of gestational diabetes increased in obese women and in first degree relatives who had diabetes. In this study 77.78% of women with GCT positive had family history (p.000, RR 15.44, OR, 4.39) and 88.89% women were obese (p < .000, or 0.104, RR 0.232). The results are comparable to study conducted by Khan in which 80% of patient with GCT positive had family history of diabetes and obesity.[11,12]

A study by NA Beischer reported significance of glycosuria in 6.8%, however in our study 46.67% GCT positive patients showed glycosuria (p < .000, OR 7.14, RR 2.36). The reason being, large difference in sampling and laboratory techniques, and geographical variation.[13]

In this study sensitivity of GCT was 90.09% and specificity 91.07%, similar rates of sensitivity and specificity has been reported in by Adegbola and Ajayi who conducted study in Nigeria and found the sensitivity and negative predictive values were all 100% at screening values of 130 mg/dl and 140 mg/dl; while the specificity was 82.4% at 130 mg/dl and 91% at 140 mg/d the only difference between our study population is use of 7.8 mmol/l as threshold for GCT rather than 7.3 mmol/l in their study.[14,15]

The diagnostic accuracy according to study by Perea Carrasco was 90% which is quite comparable to present study in which 91% diagnostic accuracy has been obtained.[16]

Pakistan being Asian country an ethnic based risk factor demand universal screening in this population and may prove cost effective in this setting as only 11.11% of false positive rate and high specificity 90%.[17] The results are supported by the study conducted in Malaysia in which universal screening strategy using 50 g GCT was able to detect an additional five out of 16 cases of GDM which risk – based screening missed, and at a significantly lower false positive rate (48.1% vs. 69.5%). They also showed the increased specificity of screening with GCT of 82.6%, when compared to 60.9% when using the risks screening strategy.[3,18]

The high prevalence of diabetes in this population potentially not identified with selective screening in this study and low cost justified the use of universal screening for gestational diabetes seems the best way to identity the patients and to avoid worse outcome.

It is **concluded** that this study emphasized the need of universal screening with glucose challenge test in Pakistani population and it may prove to be cost effective and excellent in detection of high risk cases of gestational diabetes which if not diagnosed early may associated with complications.

ACKNOWLEDGEMENTS

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