



CLINICAL PROFILE AND PREGNANCY OUTCOMES AMONG WOMEN WITH AN ABNORMAL GLUCOSE CHALLENGE TEST AT A TERTIARY CARE HOSPITAL IN NORTH COASTAL ANDHRA PRADESH

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Abstract

Background: The study aimed to assess the clinical profile and pregnancy outcomes of women with abnormal glucose challenge tests (GCT) in a tertiary care hospital in North Coastal Andhra Pradesh. Gestational diabetes mellitus (GDM) is a prevalent complication during pregnancy, marked by glucose intolerance.

Methods: The research identified 160 pregnant women with abnormal GCT results, defined as plasma glucose ≥ 140 mg/dL after a 50 g glucose load. The study revealed that 40% of those screened were diagnosed with GDM following diagnostic oral glucose tolerance testing (OGTT), while 60% did not meet GDM criteria despite abnormal screening.

Results: The analysis highlighted significant associations between maternal characteristics and pregnancy outcomes. Women aged ≥ 30 years, those with a body mass index (BMI) ≥ 25 kg/m², and those with a previous history of GDM were more likely to develop GDM. Maternal outcomes included gestational hypertension (11.3%), preeclampsia (7.5%), and a higher caesarean delivery rate (40%), particularly in the GDM group (50% vs. 33.3% in normal OGTT). Furthermore, adverse neonatal outcomes were observed, including macrosomia (9.4%), large-for-gestational-age (LGA) infants (13.8%), and increased rates of neonatal hypoglycemia (8.8%).

Conclusion: The study emphasizes the importance of considering abnormal glucose metabolism as a spectrum, advocating careful diagnostic evaluation and antenatal surveillance for women with abnormal GCT results. It also signifies the need for heightened awareness and systematic screening, particularly in the North Coastal Andhra Pradesh region, as these findings contribute to improving maternal and neonatal health outcomes based on local epidemiological data. However, the study faced limitations, including a small sample size and the focus on short-term outcomes. Larger multicentric studies are suggested for a more comprehensive understanding of GDM risk factors and their implications on pregnancy outcomes.

Keywords: abnormal glucose challenge tests, body mass index, oral glucose tolerance testing, North Coastal Andhra Pradesh.

Introduction

Abstract: Gestational diabetes mellitus (GDM) is one of the most common metabolic complications of pregnancy and is defined as glucose intolerance with onset or first recognition during pregnancy. Maternal insulin resistance is progressively increased during the course of gestation in relation to hormonal and metabolic adaptations, especially in the second and third trimesters. In women who cannot adequately compensate by increasing insulin secretion from pancreatic β -cells, maternal hyperglycaemia develops. GDM has traditionally been defined by specific diagnostic thresholds, but growing evidence suggests that maternal glucose concentrations exist on a continuum and that even modest elevations below the traditional diagnostic range may be associated with adverse pregnancy outcomes .(1,2)

Historically, the 50 g, 1 hour glucose challenge test (GCT) has been used as a convenient screening test for GDM, especially in the two-step screening strategy. Compared to a diagnostic oral glucose tolerance test (OGTT), the GCT does not require fasting and can therefore be performed more conveniently as part of routine antenatal care. Plasma glucose concentration ≥ 140 mg/dL at 1 hour has often been used as the cutoff for an abnormal screening result, but lower cutoffs such as 130 or 135 mg/dL have been used as well, depending on the population and screening strategy.(3,4) Carpenter and Coustan were the first to describe the use of the 50-g glucose screening test and diagnostic testing in women with elevated screening values.(3) Additional data have shown that the 50-g GCT has acceptable sensitivity and specificity for identifying women who need further diagnostic assessment.(4) An abnormal GCT does not necessarily mean a diagnosis of GDM. Women with an abnormal screening result are usually referred for a diagnostic OGTT, such as a 75-g or 100-g glucose tolerance test, depending on the guideline used. Subsequently, the International Association of Diabetes and Pregnancy Study Groups (IADPSG) proposed diagnostic criteria based on the relationship between maternal glucose concentrations and pregnancy outcomes, largely based on evidence from the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study.(5,6) The HAPO study, which enrolled over 23,000 pregnant women with blinded glucose results, showed continuous associations between maternal fasting, 1-hour and 2-hour glucose concentrations and outcomes such as birth weight above the 90th percentile, primary caesarean delivery, neonatal hypoglycemia and elevated cord-blood C-peptide concentrations.(6) The results demonstrated the fact that clinically important metabolic derangements may be present even in the absence of glucose levels that meet traditional criteria for GDM.

Importantly, an abnormal GCT together with a normal diagnostic OGTT does not automatically imply that there is no clinical risk at all. Previous studies have reported associations between intermediate maternal glucose abnormalities and pregnancy complications. According to Cheng et al., women with higher 1-hour GCT values were more likely to develop preeclampsia and operative delivery compared with women with lower screening glucose values.(7) A systematic review in support of the U.S. Preventive Services Task Force also showed that the 50-g GCT threshold of 140 mg/dL had moderate sensitivity and specificity for detecting GDM, supporting its continued use as a screening tool.(4) A systematic review and meta-analysis of evidence available through 2014 also documented graded associations between maternal glucose concentrations and outcomes such as caesarean delivery, induction of labour, large-for-gestational-age birth, macrosomia, and shoulder dystocia.(7,8)

Screening for abnormal glucose has important clinical implications especially in women in India. GDM

is a major maternal and public health concern due to the possible detrimental effects of pregnancy glucose intolerance on immediate obstetric outcomes and on the future metabolic health of the mother and offspring. Indian consensus guidelines have laid stress on the importance of systematic screening and appropriate management of hyperglycemia in pregnancy.(8) However, there is considerable variation in screening practices, diagnostic criteria, population characteristics and healthcare resources in different regions of India.

In routine clinical practice, women with abnormal GCT results may have different demographic and clinical characteristics, such as maternal age, parity, body mass index, gestational age at screening, and obstetric risk factors. Abnormal screening results have also been associated with pregnancy outcomes including gestational hypertension, preeclampsia, caesarean delivery, macrosomia, large for gestational age infants, neonatal hypoglycemia and other neonatal complications. Understanding these relationships may help clinicians to identify women who may benefit from closer surveillance in pregnancy, even if subsequent diagnostic testing does not meet established criteria for GDM.

The North Coastal region of Andhra Pradesh has distinct demographic, socioeconomic and healthcare characteristics and data on abnormal glucose screening during pregnancy from this region is scarce. This tertiary care hospital serving this population provides the opportunity to characterise women with abnormal GCT results and evaluate maternal and neonatal outcomes in a real-world clinical setting. Regional evidence is important since prevalence and clinical expression of glucose intolerance may differ depending on population characteristics, dietary patterns, socioeconomic factors, maternal anthropometry and access to antenatal healthcare.

Hence, the present study was conducted to assess the clinical profile and pregnancy outcome in women with abnormal glucose challenge test in a tertiary care hospital of North Coastal Andhra Pradesh. The aim of this study is to describe the maternal demographic and clinical characteristics of these women and to evaluate the association with important maternal and fetal/neonatal outcomes. Such information may be useful in better risk stratification and antenatal surveillance of women with abnormal glucose screening results in this regional population.

Materials and Methods:

Study Design and Setting: This was a hospital based observational study conducted to evaluate the clinical profile and pregnancy outcome in women with abnormal glucose challenge test (GCT). This study was conducted in Department of Obstetrics and Gynaecology, Great Eastern Medical School and Hospital (GEMS), Ragolu, Srikakulam, Andhra Pradesh which is a tertiary care teaching hospital catering to the population of North coastal Andhra Pradesh.

Study Population: Pregnant women who attended the antenatal outpatient department or were admitted to the obstetric unit during the study period (July 2014 to June 2015) were screened for eligibility. Women with an abnormal result on a 50-g oral glucose challenge test performed as part of routine antenatal care were considered for inclusion in the study.

An abnormal GCT was defined as a plasma glucose level 1 h after a 50 g oral glucose load ≥ 140 mg/dL. Women with abnormal GCT results were then evaluated with a diagnostic oral glucose tolerance test (OGTT) per institutional protocol.

Study Duration: The study was performed for a defined period of 12 months, long enough to recruit the necessary number of eligible participants and to follow them up to delivery and the immediate neonatal period.

Inclusion Criteria: Pregnant women were eligible if they met the following criteria:

1. Pregnant women attending the hospital for antenatal care.
2. singleton pregnancy.
3. Gestational age appropriate for glucose screening (typically between 24 and 28 weeks of gestation) or women screened earlier for risk factors.
4. Abnormal 50-g GCT is defined as a 1-h plasma glucose level ≥ 140 mg/dL.
5. Women who are willing to participate in the study and provide written informed consent.
6. Women who delivered in the study hospital and information on maternal and neonatal outcome was available.

Exclusion Criteria: Exclusion criteria for women were:

1. diabetes mellitus (pre-existing) before pregnancy
2. Diabetes discovered in early pregnancy
3. Multiple gestation
4. Significant pre-existing systemic disease likely to impact on the outcome of the pregnancy independent of the pregnancy.
5. Incomplete antenatal or delivery notes.
6. Women who did not deliver or received follow-up at the study hospital

Data Collection: Informed consent was obtained and relevant demographic, clinical, obstetric and laboratory information was collected on a structured data collection proforma. Variables recorded were maternal age, residence, socio-economic characteristics, parity, gravidity, gestational age at screening, body mass index, family history of diabetes mellitus, previous history of GDM, previous history of macrosomia and other relevant obstetric risk factors.

Details of the GCT, including gestational age at testing and 1-hour plasma glucose concentration, were recorded. Women with abnormal GCT results were offered a diagnostic OGTT per institutional practice. The results of the screening test were recorded and the women were classified according to whether they fulfilled the screening criteria for GDM.

Maternal Outcomes: Participants were prospectively followed until parturition. Maternal outcomes assessed were:

- diabetes mellitus, gestational
- Gestational hypertension
- Preeclampsia
- Preterm birth
- Delivery mode
- Inducing labour

- Other significant obstetric complications

Delivery mode was classified as spontaneous vaginal delivery, assisted vaginal delivery or caesarean delivery. Gestational age at birth was collected and preterm birth was defined as birth prior to 37 completed weeks of gestation.

Fetal and Neonatal Outcomes: Newborns were examined immediately after delivery. Neonatal outcomes were recorded as follows: • Weight at birth • Sex of the newborn

- Gestational age (at delivery)
- Apgar score at 1 and 5 minutes
- Large for gestational age (LGA)
- Small for gestational age (SGA) status
- Macrosomia (big baby)
- Neonatal hypoglycaemia
- Admission to a neonatal intensive care unit (NICU).

Stillbirth or early neonatal complications, if applicable Birth weight was recorded on a calibrated weighing scale. Macrosomia was defined as birth weight $\geq 4,000$ g. LGA was defined as birth weight above the 90th percentile for gestational age according to the reference standard used by the institution.

Laboratory Investigations: Blood glucose measurements were performed in the accredited clinical laboratory of the hospital, using standardised procedures and quality controlled equipment. A 50-g GCT was performed using the institutional protocol and plasma glucose was measured one hour after administration of glucose. Women with abnormal screening results were referred for diagnostic OGTT according to institutional guidelines.

Statistical Analysis:

Data were entered into a computerised database and analysed by statistical software suitable for this purpose. Continuous variables including maternal age, gestational age and birth weight were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range, depending on the distribution of the data. Categorical variables were presented as frequency and percentage.

Categorical variables were compared using the chi-square test or Fisher's exact test as appropriate. Continuous variables between groups were compared using Student's t-test for normally distributed data or the Mann-Whitney U test for non-normally distributed data. Statistical significance was accepted at $P < 0.05$. Where appropriate, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to assess the strength of association between abnormal glucose screening characteristics and adverse pregnancy outcomes.

Ethical Considerations:

The study protocol was submitted to the Institutional Ethics Committee of Great Eastern Medical School and Hospital, Srikakulam for approval before the start of the study and was approved. All study participants provided informed consent. Participant information was kept confidential throughout the study and data were used exclusively for research purposes. Participation was voluntary, and women could withdraw from the study at any time without effect on their medical care.

Results:

The study enrolled 160 pregnant women with an abnormal 50-g glucose challenge test (GCT) All the participants were followed till delivery and maternal and neonatal outcomes were recorded.

Table 1. Sociodemographic and Clinical Characteristics of Study Participants (n=160)

Characteristic	Number (n)	Percentage (%)
Age (years)		
<25	42	26.3
25–29	63	39.4
30–34	39	24.4
≥35	16	10.0
Parity		
Primigravida	76	47.5
Multigravida	84	52.5
BMI (kg/m ²)		
<18.5	8	5.0
18.5–24.9	62	38.8
25–29.9	61	38.1
≥30	29	18.1
Family history of diabetes	38	23.8
Previous history of GDM	19	11.9
Previous macrosomic baby	12	7.5

The mean age of mothers was 27.8 ± 4.6 years. Most of the women belonged to the age group 25-29 years (39.4%). Primigravidas constituted 47.5% of the study population whereas multigravidas made up 52.5%. 56.2% of the participants were overweight or obese. Twenty-three point eight percent of women had a family history of diabetes mellitus, while 11.9% had a previous history of GDM.

Table 2. Glucose Challenge Test and OGTT Findings

Parameter	Number (n)	Percentage (%)
1-hour GCT value		
140–159 mg/dL	91	56.9
160–179 mg/dL	43	26.9
≥180 mg/dL	26	16.3
Diagnostic OGTT		
Normal	96	60.0
GDM diagnosed	64	40.0

The mean GCT level at 1 hour was 159.4 ± 23.7 mg/dL. Most women (56.9%) had a GCT ≥ 140 mg/dL and <159 mg/dL and 16.3% had a GCT value ≥ 180 mg/dL. Diagnostic OGTT resulted in the diagnosis of GDM in 64 (40.0%) women, whereas 96 (60.0%) women had an abnormal screening test but did not meet the diagnostic criteria for GDM.

Table 3. Association Between Maternal Characteristics and GDM

Variable	GDM n (%)	Normal OGTT n (%)	p-value
Age ≥ 30 years	25 (39.1)	30 (31.3)	0.295
BMI ≥ 25 kg/m ²	45 (70.3)	45 (46.9)	0.004
Family history of diabetes	20 (31.3)	18 (18.8)	0.057
Previous GDM	12 (18.8)	7 (7.3)	0.027
Previous macrosomia	7 (10.9)	5 (5.2)	0.183
Multigravida	38 (59.4)	46 (47.9)	0.157

Frequency of GDM was significantly higher among women with BMI ≥ 25 kg/m² compared to women with BMI < 25 kg/m² (70.3% vs. 46.9%; $p=0.004$). History of GDM in previous pregnancy was also significantly associated with GDM diagnosis in current pregnancy (18.8% vs 7.3%; $p=0.027$).

Table 4. Maternal Pregnancy Outcomes (n=160)

Maternal outcome	Number (n)	Percentage (%)
Gestational hypertension	18	11.3
Preeclampsia	12	7.5
Preterm delivery	19	11.9
Induction of labour	48	30.0
Vaginal delivery	91	56.9
Cesarean delivery	64	40.0
Assisted vaginal delivery	5	3.1

Gestational hypertension was observed in 18 (11.3%) and preeclampsia in 12 (7.5%) of the 160 women. 19 (11.9%) pregnancies were delivered prematurely. Induction of labour was carried out in 30.0% of women. 56.9% of them had vaginal delivery and 40.0% had caesarean delivery.

Table 5. Neonatal Outcomes

Neonatal outcome	Number (n)	Percentage (%)
Birth weight < 2.5 kg	17	10.6
Birth weight 2.5–3.99 kg	128	80.0
Birth weight ≥ 4.0 kg	15	9.4
Large-for-gestational-age	22	13.8
Neonatal hypoglycemia	14	8.8
NICU admission	18	11.3
Apgar < 7 at 5 minutes	6	3.8
Stillbirth	2	1.3

The average birth weight was 3.02 ± 0.51 kg. Macrosomia (birth weight $\geq 4,000$ g) was observed in 15 neonates (9.4%). LGA was seen in 22 (13.8%) of the newborns. Neonatal hypoglycemia was seen in 14

(8.8%) neonates. NICU admission was required in 18 (11.3%) neonates. Six (3.8%) neonates had an Apgar score <7 at 5 minutes. Two still birth reported.

Table 6. Pregnancy Outcomes According to Diagnostic OGTT Status

Outcome	GDM (n=64)	Normal OGTT (n=96)	p-value
Gestational hypertension	10 (15.6%)	8 (8.3%)	0.158
Preeclampsia	7 (10.9%)	5 (5.2%)	0.189
Preterm delivery	10 (15.6%)	9 (9.4%)	0.232
Cesarean delivery	32 (50.0%)	32 (33.3%)	0.038
Macrosomia	10 (15.6%)	5 (5.2%)	0.030
LGA	14 (21.9%)	8 (8.3%)	0.016
Neonatal hypoglycemia	9 (14.1%)	5 (5.2%)	0.048
NICU admission	10 (15.6%)	8 (8.3%)	0.158

Women diagnosed with GDM following an abnormal GCT had a significantly higher rate of caesarean delivery (50.0% vs 33.3%, $p = 0.038$), macrosomia (15.6% vs 5.2%, $p = 0.030$), LGA neonates (21.9% vs 8.3%, $p = 0.016$) and neonatal hypoglycemia (14.1% vs 5.2%, $p = 0.048$) compared with women with a normal diagnostic OGTT.

Discussion:

The present study was undertaken to assess the clinical profile and pregnancy outcome in 160 pregnant women with abnormal 50 g glucose challenge test (GCT) in a tertiary care hospital in North Coastal Andhra Pradesh. In the present study, 40.0% of women with an abnormal GCT were subsequently diagnosed with gestational diabetes mellitus (GDM) on diagnostic oral glucose tolerance testing (OGTT), whereas 60.0% had an abnormal screening test but did not meet the diagnostic criteria for GDM. This finding underscores that the GCT is in fact a screening test and an abnormal result requires appropriate diagnostic confirmation and should not be considered diagnostic of GDM. The 50-g, 1-hour GCT has been widely used as a practical screening approach since it can be performed without fasting and identifies women who require further diagnostic evaluation.(3) The mean age of mothers in our study was 27.8 ± 4.6 years and most of the participants belonged to the age group of 25–29 years. The association was not statistically significant, but GDM was somewhat more common in women aged ≥ 30 years. The increasing maternal age is a known risk factor for GDM but the lack of statistical significance in the present study may be attributed to the relatively small sample size and the age distribution of the study population. The relatively young age distribution of the mothers could be explained by the demographic profile of women who seek obstetric care in the study area.

The main result was a strong association between maternal overweight/obesity and GDM. In the present study, 70.3% of women with GDM had BMI ≥ 25 kg/m² compared to 46.9% of women with normal diagnostic OGTT ($p=0.004$). Increased maternal adiposity is strongly associated with insulin resistance and physiological insulin resistance of pregnancy may be physiologically evident in women with increased adiposity. The HAPO study showed that maternal glucose levels were continuously associated with foetal overgrowth and other adverse outcomes, even at glucose concentrations below

those used to define overt diabetes.(2) GDM in a previous pregnancy was also significantly associated with GDM in the current pregnancy. Among women diagnosed with GDM, 18.8% had a previous history of GDM as opposed to 7.3% among women with a normal OGTT ($p=0.027$). This finding is in keeping with the known recurrence of GDM in subsequent pregnancies and supports the importance of taking a detailed obstetric and metabolic history at the time of the antenatal assessment. The Indian consensus recommendations have emphasised the necessity of identifying women at high risk of GDM and appropriate glucose testing during pregnancy.(8)

The present study also showed clinically significant pregnancy outcomes in women with abnormal GCT results. Gestational hypertension occurred in 11.3% and preeclampsia in 7.5%. These results were more frequent among women subsequently diagnosed with GDM, but the differences were not statistically significant. The HAPO study demonstrated a continuous relationship between maternal glucose concentrations and pregnancy complications, including preeclampsia, which supports the biological relationship between maternal dysglycemia and adverse obstetric outcomes.(9) The absence of statistical significance in this study should therefore not be interpreted as lack of association, especially because of the small sample size.

Caesarean delivery was performed in 40.0% of the total study population, which was significantly higher in women with confirmed GDM compared to women with a normal OGTT (50.0% vs. 33.3%; $p=0.038$). Increased operative delivery in women with abnormal glucose metabolism may be caused by several factors, including foetal macrosomia, excessive foetal growth, obstetric interventions and related maternal complications. The HAPO study also showed a positive association between increasing maternal glucose concentrations and primary caesarean delivery.(2) This study's noteworthy finding was the increased frequency of adverse neonatal outcomes among women with GDM diagnosis. Macrosomia was seen in 15.6% of infants born to mothers with GDM compared to 5.2% of infants born to mothers with a normal OGTT ($p=0.03$). Similarly, LGA infants were significantly more common in women with GDM (21.9% vs. 8.3%; $p=0.016$). These results are biologically plausible as maternal hyperglycemia increases foetal glucose exposure, which stimulates foetal insulin secretion and promotes foetal growth and adiposity. The HAPO study reported strong continuous associations between maternal glucose concentrations and birth weight greater than the 90th percentile and higher cord-blood C-peptide concentrations.(2,10)

Neonatal hypoglycemia was also significantly higher in the GDM group (14.1% vs. 5.2%, $p=0.048$). Maternal hyperglycemia may induce foetal hyper insulinemia . Prolonged neonatal insulin secretion after birth may predispose the newborn to hypoglycemia when maternal glucose supply is suddenly interrupted . Maternal glycemia and neonatal hypoglycemia have been associated in large international studies.(2,14)

It is of particular interest that 60% of women in our study had an abnormal GCT but a normal subsequent OGTT. An abnormal screening test in the absence of diagnostic GDM has been considered on occasion to be a relatively benign finding. However, there is evidence that women with an abnormal GCT may still be at increased risk of selected adverse pregnancy outcomes. In a large retrospective study, women with an abnormal GCT but normal OGTT had increased risks of macrosomia, LGA, caesarean delivery, respiratory morbidity, and neonatal hypoglycemia compared with women with a normal GCT.(11,15) False-positive GCT has also been associated with adverse perinatal outcomes in

prior studies. (12) The results are consistent with the idea that glucose intolerance in pregnancy can be a continuum rather than a simple dichotomous situation.

The findings of the current study are of particular importance in the North Coastal Andhra Pradesh where there is still limited regional evidence on abnormal glucose screening in pregnancy. Women with abnormal GCT results can be targeted for increased antenatal surveillance, dietary counselling and appropriate diagnostic testing. The findings also underline the importance of maternal BMI and previous GDM to be considered when evaluating the overall metabolic risk of pregnant women.”

The study has its limitations. A single tertiary care institution was used for this study, and the small sample size may limit the generalisability to the wider population. In addition, management practices, dietary patterns and referral characteristics may influence the pregnancy outcome. The study primarily looked at short-term maternal and neonatal outcomes but did not look at long-term metabolic outcomes in the mothers or the offspring. Larger prospective multicentric studies among women from different populations of North Coastal Andhra Pradesh would provide stronger evidence.

Conclusion:

Overall, an abnormal 50-g GCT identified a large proportion of pregnant women who later had GDM on diagnostic testing. In the present study, 40% of women with an abnormal GCT were diagnosed with GDM. The risk of subsequent GDM was significantly associated with maternal BMI ≥ 25 kg/m² and previous GDM.

Women with confirmed GDM had increased rate of caesarean delivery, macrosomia, LGA and neonatal hypoglycemia compared to women with abnormal GCT but normal diagnostic OGTT. These findings emphasise the importance of proper diagnostic evaluation following an abnormal GCT and careful antenatal and perinatal surveillance of women with abnormal glucose screening results.

Our findings also emphasise the need to consider abnormal glucose metabolism in pregnancy as a spectrum rather than a dichotomous diagnosis of GDM. Early identification and suitable care of women with an increased metabolic risk may help to decrease adverse maternal and neonatal outcomes. Regional studies such as the present one can provide useful evidence for improving antenatal screening and management in North Coastal Andhra Pradesh.

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