

Original article

GESTATIONAL DIABETES IN LUMPHUN HOSPITAL: PREVALENCE, CLINICAL RISK FACTORS AND PREGNANCY OUTCOMES

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Abstract

Objective: To determine prevalence of gestational diabetes mellitus (GDM), clinical risk factors and pregnancy outcomes of pregnant women at Lumphun hospital

Study design: Retrospective descriptive study

Materials and methods: **Part 1;** Medical records of 637 women attending antenatal care at Lumphun hospital between July 2006 and May 2007 were reviewed. These were divided into 2 groups as with and without GDM according to individual risk factors, 50 gm glucose challenge test (GCT) and 100 gm oral glucose tolerance test (OGTT). Clinical risk factors and plasma glucose of GCT were compared between two groups. **Part 2;** 377 women who delivered during July 2006 to May 2007 were recruited and classified into 4 groups. Those without risk factors, those with risk factors and normal GCT, those with abnormal GCT and normal OGTT, and those with abnormal GCT and OGTT were defined as group 1, 2, 3 and 4 respectively. Pregnancy outcomes were compared among these groups.

Results: **Part1;** The prevalence of GDM in Lumphun hospital is 1.5% (10 from 637 cases). False positive rate of GCT is high as 75% (31 from 41 cases). Pregnant women with GDM are more likely to have higher plasma glucose from GCT than those without GDM. If the result of GCT is higher than 180 mg/dL, risk of GDM is increased significantly (P-value 0.006) and pregnant women with GDM are more likely to be obese (P-value 0.047). Moreover, if the pregnant women had at least 3 risk factors, they are more likely to be GDM (P-value 0.003) **Part2;** When compared with group 1, risk of cesarean delivery, infant's head circumference, maternal and neonatal complications are increased significantly in group 2, 3 and 4 pregnant women (P-value 0.015, 0.018, 0.001 and 0.001 respectively).

Conclusion: Pregnancy with GCT higher than 180 mg/dL, obesity or has at least 3 risk factors has high possibility to be GDM. Moreover, pregnancy with glucose intolerance or GDM has increase risk of adverse pregnancy outcomes. **Chiang Mai Med J 2008;47(2):65-73.**

Keywords: Gestational diabetes mellitus, 50 gm glucose challenge test, pregnancy outcome

Diabetes Mellitus is one of the most common medical complications in pregnancy. Gestational Diabetes Mellitus (GDM) is defined as carbohydrate intolerance of variable severity, with onset or first recognition during pregnancy.⁽¹⁾ The incidence of GDM varies between 1-16%.⁽²⁻⁷⁾ Undiagnosed or poorly controlled GDM not only increases perinatal morbidity and mortality 2-5 fold,⁽⁸⁻¹²⁾ but also increases adverse maternal outcome.

Recent studies have shown that early diagnosis and treatment of GDM could improve both maternal and neonatal outcomes,⁽¹³⁻¹⁴⁾ therefore a risk-based screening method was conducted at Lumphun Hospital for screening and diagnosing GDM. Clinical risk factors for GDM,⁽¹⁵⁾ which are defined as age of ≥ 30 , family history of DM, previous history of GDM, previous macrosomia (BW $\geq 4,000$ grams), previous history of unexplained intrauterine fetal death, obesity (Body Mass Index: BMI ≥ 27 kg/m²), and glucosuria were identified at the first prenatal visit. Pregnant women who had any of the risk factors received GDM screening by using a 50-g oral glucose challenge test (50-g GCT). Women with glucose values of 140 mg/dL or greater received a 100-g oral glucose tolerance test (100-g OGTT) as a diagnostic test of GDM.⁽¹⁶⁾ Women with a negative 100-g OGTT on their first prenatal visit had repeated tests at 24-28 weeks of gestation.

The screening method of 50-g GCT using a cut-off value at 140 mg/dL, according to data from the National Diabetes Data Group (NDDG),⁽¹⁷⁾ seemed to be effective in identifying pregnant women with GDM, but the false positive rate was quite high and variable in the general population.^(18,19)

Therefore, the purpose of this study was to determine the false positive rate of the cut-off value in the 50-g GCT for screening GDM in a hospital setting in Lumphun. In addition, clinical risk factors and pregnancy outcomes among these groups of women were evaluated.

Materials and methods

This retrospective review of medical records was conducted among women attending antenatal care at Lumphun Hospital between July 2006 and May 2007. Six hundred and thirty seven pregnant women were eligible. Three hundred and seventy seven women delivered babies in that period. Exclusion criteria were pregnant women who had underlying Diabetes Mellitus (DM) before pregnancy and those who did not follow the screening protocol for GDM.

All pregnant women who had at least one clinical risk factor for GDM, from age of ≥ 30 , family history of DM, previous history of GDM, previous macrosomia (BW $\geq 4,000$ grams), previous history of unexplained intrauterine fetal death, obesity (Body Mass Index: BMI ≥ 27 kg/m²), and glucosuria, received screening by the 50-g GCT. Venous plasma glucose was measured at 1 hour after ingestion of 50 gm of glucose. Women with a plasma glucose value ≥ 140 mg/dL (positive GCT) received a diagnostic test for GDM one week later by using the 100-g OGTT. Plasma glucose was measured after overnight fasting for at least 8 hours, and 1, 2 and 3 hours after ingestion of 100-g glucose. Definite diagnosis of GDM was defined by using NDDG diagnostic criteria.⁽¹⁷⁾ If the result of 100-g OGTT was normal on the first prenatal visit, patients received screening and diagnostic tests again at 24-28 weeks of gestation.⁽²⁰⁾

A retrospective review of medical records including clinical risk factors for GDM, result of the 50-g GCT and 100-g OGTT, mode of delivery, adverse maternal outcome (hypertensive disorder, postpartum hemorrhage) and adverse neonatal outcome (large for gestational age; LGA, hypoglycemia, hyperglycemia, hypocalcemia and hyperbilirubinemia, prematurity, perinatal mortality) was carried out. The data were divided into two parts; the first part comprised 637 pregnant women who received antenatal care at Lumphun Hospital and the second part included 377 pregnant women who had completed delivery. Statistical analysis was done by using chi-square and ANOVA by rank.

Results

Part 1

From the total of 637 pregnant women, the prevalence of GDM was 1.5% (10 cases), and 126 cases (19.8%) had at least one clinical risk factor and received 50-g GCT. Forty one cases

(6.4% of total pregnant women) had positive results (plasma glucose ≥ 140 mg/dL) and only 10 of those were diagnosed GDM due to a positive 100-g OGTT. The positive predictive value (PPV) was 24% and false positive rate of 50-g GCT is as high as 75% (31 in 41 cases).

The relationship between the plasma glucose value of 50-g GCT and diagnosis of GDM is shown in Table 1. Pregnant women with GDM were more likely to have a higher plasma glucose value from the 50-g GCT than pregnant women without GDM. Moreover, when the plasma glucose value was more than 180 mg/dL, the probability of GDM increased significantly. (60.0% and 16.2%, in women with and without GDM, respectively, p -value=0.006).

Association of clinical risk factors and diagnosis of GDM are shown in Table 2. Pregnant women with GDM were more likely to be obese than those without (60% and 25.8%, respectively, p -value 0.047, RR 2.32) and they had three or more clinical risk factors than

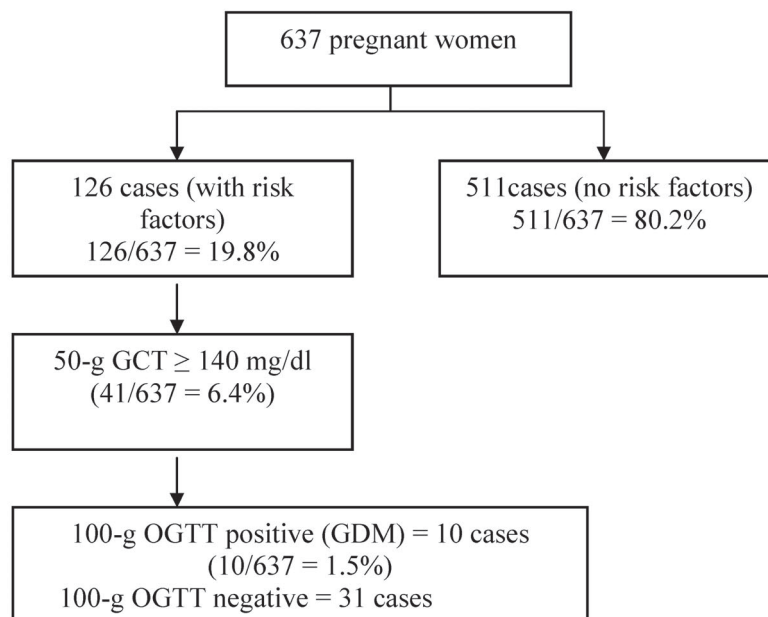


Table 1. Relationship between a plasma glucose value of 50-g GCT and diagnosis of GDM

Plasma glucose value of 50-g GCT (mg %)	GDM Cases (%)	No GDM Cases (%)	<i>p</i> -value
140 – 159	4 (40)	21(67.7)	0.046
160 – 179	0 (0)	5(16.1)	
180 – 199	5 (50)	4(12.9)	
≥ 200	1(10)	1(3.3)	
140 - 179	4 (40)	26 (83.8)	0.006
≥ 180	6 (60)	5 (16.2)	
Total (cases)	10	31	

Table 2. Association of clinical risk factors and diagnosis of GDM

Clinical risk factors	GDM Cases (%)	No GDM Cases (%)	<i>p</i> -value	Risk ratio (95% CI)
Maternal age ≥ 30	7 (70)	19 (61.3)	0.619	1.14 (0.70-1.87)
Family history of DM	3 (30)	8 (25.8)	0.795	1.16 (0.38-3.56)
Previous macrosomia, unexplained fetal death and GDM	9 (90)	29 (93.6)	0.708	0.96 (0.76-1.20)
Obesity (BMI ≥ 27 kg/m ²)	6 (60)	8 (25.8)	0.047	2.32 (1.06-5.08)
Number of clinical risk				
1	1 (10)	3 (9.7)	0.022	
2	3 (30)	24 (77.4)		
3	5 (50)	3 (9.7)		
4	1 (10)	1 (3.2)		
Clinical risk group				
≤ 2	4 (40)	27 (87.1)	0.003	
≥ 3	6 (60)	4 (12.9)		4.65 (1.63-13.22)
Total (Cases)	10	31		

pregnant women without GDM (60.0% and 12.9%, respectively, *p*-value 0.003, RR 4.65).

Part2

Three hundred and seventy seven pregnant women who delivered babies in that period

were enrolled, and they were classified into 4 groups. Two hundred and ninety nine pregnant women (79.3%) without clinical risk factors were defined as group 1, forty nine (13%) who had clinical risk factors, but normal 50-g GCT, were defined as group 2. Twenty three (6.1%)

regnant women with clinical risk factors and a positive 50-g GCT, but no GDM (negative 100-g OGTT), were defined as group 3, and six women (1.6%) who had GDM diagnosed from an abnormal 100-g OGTT were defined as group 4.

The relationship of pregnancy outcome and pregnant women in each group is shown in Table 3. Women in group 2, 3 and 4 had a significant increase in cesarean section rate, fetal head circumference, maternal complica-

tion and neonatal complication when compared to the women in group 1 (p -value 0.015, 0.018, 0.001 and 0.001, respectively).

Discussion

Gestational diabetes (GDM) is one of the most common medical complications in pregnancy. Early diagnosis and appropriate treatment can improve the prognosis, prevent maternal and neonatal morbidity and mortality. Screening for GDM with the 50-g GCT using

Table 3. Relationship of pregnancy outcome and pregnant women in each group

Outcomes	Group 1 (299 cases)	Group 2 (49 cases)	Group 3 (23 cases)	Group 4 (6 cases)	P-value
Gestation age at delivery (weeks) Mean \pm SD	38.1 \pm 2.2	38.4 \pm 1.4	38.2 \pm 2.6	37.5 \pm 6.7	0.290*
Birth weight (gm) Mean \pm SD	2883.6 \pm 477.6	2961.1 \pm 472.4	3003.5 \pm 491.2	3361.7 \pm 399.0	0.054*
Infant length (cm) Mean \pm SD	50.4 \pm 4.8	50.8 \pm 2.8	51.2 \pm 2.2	52.8 \pm 1.6	0.161*
Infant head circumference (cm) Mean \pm SD	32.5 \pm 3.1	32.9 \pm 1.8	33.5 \pm 1.7	34.2 \pm 0.8	0.018*
APGAR score 5 min Mean \pm SD	9.9 \pm 0.8	9.6 \pm 1.7	10.0 \pm 0	10.0 \pm 0	0.352*
Gender (cases, %)					
Male	153(51.2)	24 (49)	18 (78.3)	4 (66.7)	0.070**
Female	146 (48.8)	25 (51)	5 (21.7)	2 (33.3)	
Mode of delivery (cases, %)					
Vaginal delivery	284 (82.9)	39 (79.6)	14 (60.9)	3 (50)	0.015**
Cesarean delivery	51 (17.1)	10 (20.4)	9 (39.1)	3 (50)	
Maternal complications (cases, %)	22 (7.4)	4 (8.2)	4 (17.4)	3 (50)	0.001**
Neonatal complications (cases, %)	27 (9)	7 (14.3)	6 (26.1)	3 (50)	0.001**

* ANOVA by rank

** Chi-square test

140 mg/dL as a cut-off value is universally accepted.^(21,22) However, the false positive rate of this cut-off point is still high, which leads to unnecessary diagnostic testing (100-g OGTT) in many women.^(18,19) In this study, the false positive rate from the 50-g GCT using 140 mg/dL as a cut-off value was as high as 75% of the female subjects in Lumphun Hospital. Moreover, the PPV in this study was quite low (24%). In some studies the PPV was found to increase if a higher cut-off value was used such as 180 mg/dL and 200 mg/dL, which gave a PPV as high as 50-95% and 79-100%, respectively.⁽²³⁾

The method to identify the best cut-off value of the test is the Receiver-operator characteristic curve (ROC curve).^(17,24-27) Nevertheless, according to the many limitations of this study, which lacked information about the specificity of each cut-off value, the ROC could not be demonstrated from our data. However, the result from this study showed that pregnant women with GDM were more likely to have a higher plasma glucose level from the 50-g GCT than women without GDM. When the plasma glucose level in the 50-g GCT is more than 180 mg/dL, the probability of GDM is high (6 in 11 cases, 54.5%). Otherwise, a plasma glucose level below 180 mg/dL in the 50-g GCT gives a GDM probability of only 13.3% (4 in 30 cases).

In this study, the significant clinical risk factor for GDM was obesity (defined as BMI > 27 kg/m²) with a risk ratio of 2.32. This was similar to previous studies from Siriraj Hospital and Khine ML, *et al.* and one study of GDM in adolescence, which found that body mass index (BMI) was an important risk factor for development of GDM in teenage pregnancies.⁽²⁸⁻³⁰⁾ Although a history of GDM in

previous pregnancies was the most significant clinical risk factor (with an odds ratio of 14.5) in Asian pregnant women in one study,⁽³¹⁾ a statistical significance was not found in this study. The explanation of this finding may be from the methodology used in categorizing clinical risk factors. In Lumphun Hospital, a history of bad obstetrics such as previous GDM, previous fetal macrosomia and previously unexplained fetal death is categorized into one group, therefore, the result of this study did not find any statistical significance in this group of clinical risk factors. Moreover, a previous study from Siriraj Hospital found that family history of DM, age ≥ 30 years, history of unexplained fetal death, and obesity were significant clinical risk factors for GDM,^(28,29) which was different from this study. These differences might result from the limited sample size and different characteristics of the northern Thai population in Lumphun Hospital when compared to the population in Bangkok. However, the result of our study also found that pregnant women with at least three clinical risk factors had a significant probability of having GDM, and this finding was similar to that of the previous study from Bangkok's Siriraj Hospital.⁽³²⁾

The relationship between pregnancy outcome and GDM was demonstrated in this study. Infants of pregnant women with GDM had a significantly larger head circumference when compared with those without GDM. Moreover, pregnant women with GDM had significantly more risk of cesarean delivery. This finding may be a consequence of a larger fetal head circumference and birth weight, which increases the risk of cephalopelvic disproportion (CPD). Interestingly, even pregnant women with clinical risk factors of GDM, or

those with glucose intolerance (but not diagnosed GDM) in group 2 and 3, have a larger fetal head circumference, birth weight and increase risk of cesarean delivery compared to women without clinical risk factors of GDM (group 1). In addition, this study found that the fetal head circumference, birth weight and risk of cesarean delivery increased depending on the severity of glucose intolerance, therefore, fetal head circumference and risk of cesarean delivery is highest in pregnant women with GDM (group 4). This finding is consistent with the theory that pregnant women with GDM are at increased risk of adverse pregnancy outcome.

Limitations of this study not only include the limited number of pregnant women with GDM (10 cases), but also limited data, therefore, the ROC curve to identify the most appropriated cut-off value of the 50-g GCT in Lumphun Hospital cannot be demonstrated. Nevertheless, the results of this study show that the false positive rate of the 50-g GCT is quite high and pregnant women with obesity and at least three clinical risk factors for GDM should receive early detection of GDM. Moreover, labor progression of pregnant women with GDM should be monitored closely for early detection of cephalopelvic disproportion (CPD) and risk of cesarean delivery. Furthermore, another limitation of this study was the lack of data on pregnancy outcome of all 637 pregnant women. With limited time, only 377 women delivered babies during the study period. Therefore, the pregnancy outcome of the other 260 women was insufficient. However, further study with a larger sample size is required in order to obtain more reliable results, which can be applied to the population in Lumphun Hospital.

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ภาวะเบาหวานในสตรีตั้งครรภ์ของโรงพยาบาลลำพูน: การตรวจคัดกรอง ความเสี่ยงทางคลินิกและผลลัพธ์การตั้งครรภ์

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บทคัดย่อ

วัตถุประสงค์: ศึกษาความชุกของการเกิดภาวะเบาหวานในสตรีตั้งครรภ์และหาความเสี่ยงรวมถึงผลลัพธ์การตั้งครรภ์ของสตรีที่เป็นเบาหวาน

วิธีการศึกษา: เป็นการศึกษาเชิงพรรณนา **ตอนที่ 1;** รวบรวมข้อมูลของสตรีตั้งครรภ์ที่ไม่มีภาวะเบาหวานมาก่อนและฝากครรภ์ ที่โรงพยาบาลลำพูน ระหว่างเดือนกรกฎาคม 2549 ถึง พฤษภาคม 2550 จำนวน 637 คน โดยสตรีที่มีความเสี่ยงต่อการเกิดเบาหวานจะได้รับการตรวจคัดกรองด้วยวิธี 50-g GCT และวินิจฉัยด้วยวิธี แบ่งเป็น 2 กลุ่มคือกลุ่มที่เป็นและไม่เป็นเบาหวาน เปรียบเทียบระดับน้ำตาลในกระแสเลือดหลังจากทำ 50-aGCT และปัจจัยเสี่ยงทางคลินิก **ตอนที่2;** รวบรวมข้อมูลของสตรีที่คลอดระหว่างเดือนกรกฎาคม 2549 ถึง พฤษภาคม 2550 จำนวน 377 คน แบ่งเป็น 4 กลุ่ม ได้แก่ กลุ่มที่ไม่มีความเสี่ยงทางคลินิก กลุ่มที่มีความเสี่ยงแต่ผลการคัดกรองด้วยเป็นปกติ กลุ่มที่ผลการคัดกรองผิดปกติ แต่การวินิจฉัยปกติ และกลุ่มที่ผิดปกติทั้งผลการคัดกรองและการวินิจฉัยเป็นกลุ่มที่ 1 ถึง 4 ตามลำดับ เปรียบเทียบผลลัพธ์ของการตั้งครรภ์ระหว่าง 4 กลุ่มดังกล่าว

ผลการศึกษา: **ตอนที่ 1;** ความชุกของภาวะเบาหวานในสตรีตั้งครรภ์ของโรงพยาบาลลำพูนเท่ากับร้อยละ 1.5 (10 จาก 637 ราย) และผลบวกตรงของการตรวจคัดกรองด้วย 50-g GCT มีค่าสูงถึงร้อยละ 75 (31 จาก 41 คน) สตรีตั้งครรภ์ที่เป็นเบาหวานมีระดับ น้ำตาลในกระแสเลือดจากการตรวจ 50-g GCT สูงกว่าสตรีตั้งครรภ์ที่ไม่เป็นเบาหวาน โดยเฉพาะ ในกรณีที่ระดับน้ำตาลมากกว่า 180 มก/ดล จะเพิ่มความเสี่ยงของการเป็นเบาหวานอย่างมีนัยสำคัญ (p-value = 0.006) นอกจากนี้สตรีที่เป็นเบาหวาน มีน้ำหนักตัวมากกว่า สตรีที่ไม่เป็นเบาหวานอย่างมีนัยสำคัญทางสถิติ (p-value = 0.047) และถ้าสตรีตั้งครรภ์มีความเสี่ยงตั้งแต่ 3 ข้อขึ้นไปจะมีโอกาสเป็นเบาหวานมากกว่าสตรีที่มีความเสี่ยงไม่ถึง 3 ข้ออย่างมีนัยสำคัญ (p-value = 0.003) **ตอนที่2;** สตรีตั้งครรภ์ในกลุ่มที่ 2, 3 และ 4 มีความเสี่ยงต่อการผ่าตัดคลอด ขนารอบศีรษะของทารกใหญ่ และมีภาวะแทรกซ้อนของมารดาและทารกสูงขึ้นอย่างมีนัยสำคัญทางสถิติ เมื่อเทียบกับสตรีในกลุ่ม 1 (p-value = 0.015, 0.018, 0.001 และ 0.001 ตามลำดับ)

สรุป: สตรีที่มีการตรวจ 50-g GCT มากกว่า 180 มก/ดล สตรีที่มีภาวะอ้วน และผู้ที่มีความเสี่ยงอย่างน้อย 3 ข้อ มีโอกาสสูงที่จะเป็นเบาหวานในระหว่างตั้งครรภ์ การมีภาวะ glucose intolerance หรือการเป็นเบาหวานในระหว่างตั้งครรภ์ จะเพิ่มผลลัพธ์ที่ไม่ดีของการตั้งครรภ์ได้ **เชียงใหม่เวชสาร 2551;47(3):65-73.**

คำสำคัญ: ภาวะเบาหวานระหว่างตั้งครรภ์, 50 กรัม glucose challenge test, ผลลัพธ์การตั้งครรภ์