Incidence of Gestational Diabetes Mellitus Diagnosed before 20 Weeks of Gestation

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The objectives of this study were to determine the incidence of gestational diabetes mellitus (GDM) before 20 weeks of gestation and evaluate associated risk factors. A total of 1200 pregnant women who started their antenatal care at Siriraj Hospital before 20 weeks of gestation and were at risk of developing GDM were enrolled. A 50-gram glucose challenge test was used as a screening method and 100-gram oral glucose tolerance test was used to diagnose the condition. All women were screened during their first visit and again at 28-32 weeks of gestation. The results showed that the incidence of GDM diagnosed before 20 weeks of gestation was 5.3% (95% CI 4.1-6.7%), and another 4.9% were diagnosed during 28-32 weeks. This demonstrated the usefulness and effectiveness of the current guideline for GDM screening that approximately half of women with GDM could be diagnosed early in their pregnancies. The 2 independent risks for developing GDM before 20 weeks of gestation were age ≥ 30 years and GDM in previous pregnancy (adjusted OR 2.5, 95% CI 1.3-5.0, and 7.1, 95% CI 1.8-27.6, respectively). This specific group of women should be counseled regarding the importance of early GDM screening during their pregnancy.

Keywords : *Gestational diabetes mellitus, Incidence, Risk factors*

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Gestational diabetes mellitus (GDM) is one of the most common complications during pregnancy. Pregnant women with undiagnosed or poorly-controlled GDM possess higher risks for maternal and fetal complications.[1-4] Early diagnosis and treatment is the most important issue in managing these women to control plasma glucose level in order to avoid morbidities and mortalities.[5-8] Various screening programs have been proposed and utilized by many groups of experts for early detection of GDM.[1] However, there is still no consensus on the most appropriate screening and diagnostic scheme for GDM, including the selection of pregnant women to be screened for.

Recently, a risk factor-based selective screening program has been developed and implemented in Siriraj Hospital.[9] Risks for developing GDM are identified in all pregnant women during their first visit at antenatal care clinic. Those with any risk will enter the screening and diagnostic system. A 2-step approach has been utilized, consisting of a 50-gram glucose challenge test (50-g GCT) as a screening method and 100-gram oral glucose tolerance test (OGTT) as a confirmatory method for GDM diagnosis. With this improved systematic approach, the incidence of GDM in our institution has been reported to be 6.2% among high-risk women and 2.5% of all pregnant women.[9]

Since the key issue in the successful management of GDM is the early diagnosis and treatment, the main objective of this study was to determine the incidence of GDM that could be diagnosed before 20 weeks of gestation among high-risk pregnant women. In addition, risk factors associated with such early diagnosis were also evaluated.

Material and Method

Between January and August 2001, a total of 1200 pregnant women who were at risk for GDM and first attended antenatal clinic at Siriraj Hospital before 20 weeks of gestation and agreed to participate were enrolled. Informed consent was given to each

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participant. Clinical risks for GDM include family history of DM, age of 30 years or more, history of macrosomic infant, congenital fetal anomaly, unexplained intrauterine fetal death, hypertension, GDM in previous pregnancy, and obesity (body mass index $\geq$ 27 kg/m^2).[9] According to the guideline used in this institution, a 2-step approach was used to screen and diagnose GDM. The protocol can be described as follows:

During the first visit, a 50-g GCT was used for screening in each woman. The test was performed by loading 50 gram of glucose orally, followed by determination of plasma glucose level 1 hour later. The test result was considered abnormal when plasma glucose level $\geq$ 140 mg/dL. An OGTT was used to diagnose GDM only if the result of 50-g GCT was abnormal. In fasting condition, 100 grams of glucose was loaded orally, followed by plasma glucose levels determination at baseline and hourly for 3 hours. Diagnosis of GDM was made when any 2 of 4 plasma glucose levels met or exceeded the value of 105, 190, 165, and 145 mg/dL at baseline, 1, 2 and 3 hours respectively. When the diagnosis of GDM was made, pregnant women were counseled and treated individually following the treatment guideline as appropriate. Those with normal test results would receive similar testing scheme and management again during 28-32 weeks of gestation.

Baseline data and data regarding clinical risk factors, screening and diagnostic test results were collected and extracted from antenatal care record forms. Incidence of GDM was determined among this group of women. Student t-test and Chi square test were used for comparison of baseline characteristics and risk factors were made between those diagnosed with GDM and those with normal test results. Relative risks and their 95% confidence intervals were estimated for each clinical risk. Multiple logistic regression analysis was performed to determine the independent risk factor for developing GDM before 20 weeks of gestation. A p-value $\leq$ 0.05 was considered to be statistical significance.

This study has been approved by the Ethical Clearance Committee on Human Rights related to Research involving Human Subjects from our institution.

Results

Among 1200 pregnant women before 20 weeks of gestation who were at risk for GDM, the mean age was 30.6 $\pm$ 5.7 years. Average gestational age at their first visit was 12.1 $\pm$ 4.5 weeks. They were nulliparous in 462 women (38.5%), and only 219 women (18.2%) had 2 children or more. Clinical risks for GDM were displayed in Table 1. Three most common risk factors among this population were age $\geq$ 30 years (69.1%), family history of DM (40.3%), and obesity (10.0%).

After the first screening, GDM was diagnosed in 63 women; hence the incidence was 5.3% (95% CI 4.1-6.7%). When the remaining 1137 women were re-tested during 28-32 weeks of gestation, another 56 women (4.9%) were diagnosed with GDM.

Comparison was made between those diagnosed with GDM gestation and those with normal test results before 20 weeks of gestation. The results were shown in Table 2.

Women with GDM were significantly older than those without the disease before 20 weeks of gestation ($p < 0.001$). Gestational age at first screening and parity were comparable between the 2 groups.

Probability of being diagnosed with GDM among each clinical risk factor as well as relative risk was estimated and the results were shown in Table 3. The majority of clinical risks increased the risk for developing GDM before 20 weeks of gestation, except family history of DM, previous macrosomic infant, and congenital fetal anomaly. The only 2 risk factors that

Table 1. Clinical risks for GDM (N =1200)

Risk factors	N (%)
Family history of DM	483 (40.3)
Age $\geq$ 30 years	829 (69.1)
Previous macrosomic infant	26 (2.2)
Previous congenital fetal anomaly	19 (1.6)
Previous unexplained fetal death	9 (0.8)
Hypertension	27 (2.3)
Previous GDM	13 (1.1)
Obesity	120 (10.0)

Table 2. Comparison between women with and without GDM before 20 weeks of gestation

Characteristics	GDM	No GDM	P value
Age	33.7$\pm$4.7	30.4$\pm$5.7	< 0.001*
GA	11.5$\pm$4.1	12.1$\pm$4.6	0.294*
Parity			
0	23 (5.0)	439 (95.0)	0.552**
1	31 (6.0)	488 (94.0)	
> =2	9 (4.1)	210 (95.9)	

* Student's t test ** Chi square test

Table 3. Probability of being diagnosed with GDM for each clinical risk factor

Risk factors	N	GDM	RR (95% CI)	P value*
Family history of DM				
No	717	41 (5.7)	1.0	0.376
Yes	483	22 (4.6)	0.8 (0.5-1.3)	
Age ≥ 30 years				
No	371	10 (2.7)	1.0	0.007
Yes	829	53 (6.4)	2.4 (1.2-4.6)	
Previous macrosomic infant				
No	1174	63 (5.4)	1.0	1.000**
Yes	26	1 (3.8)	0.7 (0.1-5.0)	
Previous congenital fetal anomaly				
No	1181	62 (5.2)	1.0	1.000**
Yes	19	1 (5.3)	1.0 (0.1-6.9)	
Previous unexplained fetal death				
No	1191	62 (5.2)	1.0	0.386**
Yes	9	1 (11.1)	2.1 (0.3-13.8)	
Hypertension				
No	1173	60 (5.1)	1.0	0.165**
Yes	27	3 (11.1)	2.2 (0.7-6.5)	
Previous GDM				
No	1187	60 (5.1)	1.0	0.027**
Yes	13	3 (23.1)	4.6 (1.6-12.7)	
Obesity				
No	1080	55 (5.1)	1.0	0.463
Yes	120	8 (6.7)	1.3 (0.6-2.7)	

* Chi square test ** Fisher exact test

significantly increased the risk for developing GDM before 20 weeks of gestation were age ≥ 30 years (RR 2.4, 95% CI 1.2-4.6) and history of GDM in previous pregnancy (RR 4.6, 95% CI 1.6-12.7).

Multiple logistic regression analysis was performed to determine the independent risk factors for GDM diagnosis before 20 weeks of gestation. The results were shown in Table 4.

Similar findings to univariate analysis were observed. Only age ≥ 30 years and GDM in previous pregnancy were the only 2 independent risks for developing GDM before 20 weeks of gestation were shown in Table 4 (adjusted OR 2.5, 95% CI 1.3-5.0, and 7.1, 95% CI 1.8-27.6, respectively).

Table 4. Independent risk factors associated with GDM diagnosis before 20 weeks of gestation

Risk factors	Adjusted OR (95% CI)	P value*
Age ≥ 30 years	2.5 (1.3-5.0)	0.008
Previous GDM	7.1 (1.8-27.6)	0.005

* Chi square test

Discussion

Early diagnosis and treatment is the most important issue for the successful management of GDM. To achieve such goals, an effective screening program should be established. Universal screening of all pregnant women has been recommended and it will detect significantly more cases and facilitate early diagnosis.[10, 11] However, only a minor proportion of women without any risk developed GDM. Selective screening program similar to that used in our institution has also been recommended and reported to be a reasonable approach to identify the disease as well.[12, 13] In addition, it has been reported to be more cost-effective than universal screening program especially where resources are limited.[14]

Among women who were at risk and attended antenatal clinic early in their pregnancy, the incidence of GDM was 5.3% (95% CI 4.1-6.7%). This was slightly different from other reports mainly due to the difference in threshold value used in 50-g GCT. Lower cutoff value would increase the test sensitivity and the number of women requiring OGTT. This eventually would diagnose more women with GDM. The recommended threshold value of 140 mg/dL was used at our institution while others used 130 or 135 mg/dL as the cutoff point.[1] However, there is still not precise cost-benefit ratio of diagnosing GDM and any threshold is acceptable.[3]

Common risk factors identified in this study were age ≥ 30 years (69.1%), family history of DM (40.3%), and obesity (10.0%). Other risks were relatively uncommon with prevalence of only 1-2%.The distribution of risk factors for GDM in this study population was comparable to that of the all pregnant women at risk previously reported from the same institution. [9] Therefore the incidence of GDM should be accurate and reliable that it should not be contaminated from any selection bias.

The results of this study also showed that approximately half of the women with GDM (63 of 119, 52.9%) could be diagnosed early in their pregnancy. Earlier report has shown that 66.4% of women with GDM could be diagnosed before 24 weeks of gestation.[9] This group of women might benefit form receiving early treatment to reduce the likelihood of developing both maternal and fetal complications. Diagnosis and treatment would have been delayed for at least a few weeks or even a few months if screening was made only during early second trimester. The results also clearly demonstrated the benefit and effectiveness of our screening and diagnostic protocol. Similar findings

have been observed by others as well that early screening for GDM has the advantage of diagnosing the majority of women with the disease.[10, 11]

Significant risk factors for developing GDM early in pregnancy were age ≥ 30 years and GDM in previous pregnancy. These risks differed from the reported risks for GDM diagnosed any time during pregnancy, which were family history of DM, age ≥ 30 years, previous unexplained fetal death, and obesity. For GDM before 20 weeks of gestation, age ≥ 30 years increased the risk 2.5 times compared to younger women. Moreover, women who had GDM during previous pregnancy were 7.1 times more likely to develop GDM early in current pregnancy. Previous studies have shown that women with GDM have 33-50% likelihood of recurrence.[15, 16] Therefore, these high-risk women not only needed GDM screening but also needed it early during subsequent pregnancy.

The results have demonstrated the usefulness and effectiveness of our current guideline for GDM screening, i.e., the 2-step approach with 50-g GCT followed by OGTT among at risk women at their first visit and during 28-32 weeks of gestation. Approximately half of women with GDM were diagnosed early in their pregnancies that they would benefit from early treatment and prevention of complications. Women who were ≥ 30 years and previously had GDM were 2.5 and 7.1 times more likely to develop the disease before 20 weeks of gestation. This specific group of women should be counseled regarding the importance of GDM screening during their early pregnancy. However, further studies should be conducted to determine whether early diagnosis and treatment would improve pregnancy outcomes in comparison with those who are identified with GDM later in their pregnancies.

References

1. American College of Obstetricians and Gynecologists. Gestational Diabetes. ACOG Practice Bulletin 2001.
2. Casey B, Lucas M, McIntyre D, Leveno K. Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. Obstet Gynecol 1997; 90: 869-73.
3. Sendag F, Terek M, Itil I, Oztekin K, Bilgin O. Maternal and perinatal outcomes in women with gestational diabetes mellitus as compared to nondiabetic controls. J Reprod Med 2001; 46: 1057-62.
4. Adams K, Li H, Nelson R, Ogburn PJ, Danilenko-Dixon D. Sequelae of unrecognized gestational diabetes. Am J Obstet Gynecol 1998; 176: 1321-32.
5. Svare J, Hansen B, Molsted-Pedersen L. Perinatal complications in women with gestational diabetes mellitus. Acta Obstet Gynecol Scand 2001; 80: 899-904.
6. Nahum G, Wilson S, Stanislaw H. Early-pregnancy glucose screening for gestational diabetes mellitus. J Reprod Med 2002; 47: 656-62.
7. Bevier W, Fischer R, Jovanovic-Peterson L. Treatment of women with an abnormal glucose challenge test (but a normal oral glucose tolerance test) decreases the prevalence of macrosomia. Am J Perinatol 1999; 16: 269-75.
8. Bartha J, Martinez del Fresno P, Comino-Delgado R. Gestational diabetes mellitus diagnosed during early pregnancy. Am J Obstet Gynecol 2000; 182: 346-50.
9. Sunsaneevithayakul P, Boriboonhirunsarn D, Sutanthavibul A, Ruangvutilert P, Kanokpongsakdi S, Singkiratana D, et al. Risk factor-based selective screening program for gestational diabetes mellitus in Siriraj Hospital: result from clinical practice guideline. J Med Assoc Thai 2003; 86: 708-14.
10. Danilenko-Dixon D, Van Winter J, Nelson R, Ogburn PJ. Universal versus selective gestational screening: application of 1997 American Diabetes Association recommendations. Am J Obstet Gynecol 1999; 181: 798-802.
11. Griffin M, Coffey M, Johnson H, Scanlon P, Foley M, Stronge J, et al. Universal versus risk factor-based screening for gestational diabetes melliltus: detection rates, gestation at diagnosis and outcome. Diabetic Medicine 2000; 17: 26-32.
12. United States Preventive Services Task Force. Screening for diabetes mellitus. Guide to clinical preventive services. 2 ed. Baltimore: Williams and Wilkins; 1996: 193-208.
13. Helton M, Arndt J, Kebede M, King M. Do low-risk prenatal patients really need a screening glucose challenge test? J Fam Practice 1997; 46: 556-61.
14. Lavin JJ, Lavin B, O'Donnell N. A comparison of costs associated with screening for gestational diabetes with two-tiered and one-tiered testing protocols. Am J Obstet Gynecol 2001; 184: 363-7.
15. Gaudier F, Hauth J, Poist M, Corbet D, Cliver S. Recurrence of gestational diabetes mellitus. Obstet Gynecol 1992; 80: 755-8.
16. Moses R. The recurrence rate of gestational diabetes in subsequent pregnancies. Diabetes Care 1996; 19: 1348-50.

อุบัติการณ์ของโรคเบาหวานขณะตั้งครรภ์ที่วินิจฉัยได้ก่อนอายุครรภ์ 20 สัปดาห์

ดิฐกานต์ บริบูรณ์หิรัญสาร, ประเสริฐ ศันสนียวิทยกุล, มานพ นุชจังหรีด

การศึกษานี้มีวัตถุประสงค์เพื่อหาอุบัติการณ์ของโรคเบาหวานขณะตั้งครรภ์ที่วินิจฉัยได้ก่อนอายุครรภ์ 20 สัปดาห์ และเพื่อค้นหาปัจจัยเสี่ยงที่มีความสัมพันธ์กับการเกิดโรค ได้ทำการรวบรวมหญิงตั้งครรภ์จำนวน 1200 ราย ที่มาฝากครรภ์ที่โรงพยาบาลศิริราช ขณะอายุครรภ์น้อยกว่า 20 สัปดาห์ และมีความเสี่ยงต่อการเกิดโรคเบาหวานขณะตั้งครรภ์ ทำการตรวจคัดกรองด้วยวิธี 50-g glucose challenge test และใช้วิธี 100-g oral glucose tolerance test ในการวินิจฉัยโรคดังกล่าว หญิงตั้งครรภ์ทุกรายจะได้รับการตรวจคัดกรองและวินิจฉัยดังกล่าวเมื่อมาฝากครรภ์ครั้งแรก และระหว่างอายุครรภ์ 28-32 สัปดาห์ ผลการศึกษาพบว่าอุบัติการณ์โรคเบาหวานขณะตั้งครรภ์ก่อนอายุครรภ์ 20 สัปดาห์ เท่ากับ 5.3% (95% CI 4.1-6.7%) และอีก 4.9% สามารถวินิจฉัยได้ขณะอายุครรภ์ 28-32 สัปดาห์ ผลการศึกษานี้แสดงให้เห็นถึงประโยชน์และประสิทธิภาพของแนวทางการตรวจคัดกรองและวินิจฉัยโรคเบาหวานขณะตั้งครรภ์ที่โรงพยาบาลศิริราช ซึ่งสามารถวินิจฉัยโรคได้ตั้งแต่อายุครรภ์ไม่เกิน 20 สัปดาห์ในประมาณครึ่งหนึ่งของผู้ป่วย ปัจจัยเสี่ยงที่สำคัญต่อการเกิดโรคเบาหวานขณะตั้งครรภ์ก่อนอายุครรภ์ 20 สัปดาห์ได้แก่ อายุมารดาตั้งแต่ 30 ปีขึ้นไป และประวัติการเป็นโรคเบาหวานขณะตั้งครรภ์ในครรภ์ก่อน (adjusted OR 2.5, 95% CI 1.3 – 5.0 และ 7.1, 95% CI 1.8 – 27.6 ตามลำดับ) หญิงตั้งครรภ์ในกลุ่มเสี่ยงนี้ควรได้รับคำแนะนำเกี่ยวกับความสำคัญของการตรวจคัดกรองและวินิจฉัยโรคเบาหวานขณะตั้งครรภ์ตั้งแต่เริ่มตั้งครรภ์