The Effects of Systematic Management on Maternal and Neonatal Complications in Gestational Diabetes Subjects

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Objective: *To compare maternal and neonatal complications of gestational diabetes mellitus (GDM) between conservative and systematic management.*
Material and Method: *This retrospective cohort study was conducted at Thammasat University Hospital, Thailand. GDM subjects who were diagnosed and treated from October 2004 to March 2007 were classified as the conservative management group (CMG). The participants who were diagnosed and treated from April 2007 to September 2009 were classified as the systematic management group (SMG). SMG was ambulatory-managed per standard protocol by a multidisciplinary team (physician, diabetes nurse case manager, nutritionist and pharmacologist).*
Results: *There were 87 and 118 subjects in CMG and SMG, respectively. Mean age and body mass index before pregnancy in CMG and SMG were not statistical different. Oral glucose tolerance tests (50 and 100 gram) were similar in both groups. The prevalence of GDM A2 was 57.5 and 55.1% in CMG and SMG, respectively. Mean gestational age at DM clinic consultation and number of hospital admission of SMG was less than CMG ($p<0.001$). Neonatal hypoglycemic episode in SMG was less than CMG (1.7 vs. 10.3; $p = 0.007$). Postpartum 75-gram glucose tolerance test appointments and percentages of underwent in SMG were more than CMG ($p<0.001$). Other composite maternal and neonatal outcomes were not different in either group.*
Conclusion: *Systematic management by a multidisciplinary team conducted according to a practical guideline has the benefit of neonatal hypoglycemia reduction and hospital admission included postpartum DM surveillance increments.*

Keywords: *Systematic management, Gestational diabetes mellitus*

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Gestational diabetes mellitus (GDM) is one of the causes of complications in both parturient and neonates. Incidence of GDM was 1-14 percent depend on race and diagnostic criteria[1]. Previous Thai study, the prevalence of GDM in high risk was range between 5.1 and 20.2%[2-7]. During antepartum period, pregnancy induced hypertension, preterm birth, fetal macrosomia, polyhydramnios and unexplained intrauterine fetal death were higher in GDM than normal pregnant women. The most frequent complication was macrosomia due to transmission of high blood sugar levels from pregnant women to their fetuses. High blood sugar levels in fetuses induced fetal insulin secretion and pancreas hyperplasia. Macrosomia caused delivery difficulty, shoulder dystocia, increased cesarean section rates and neonatal hypoglycemia. As to long-term complications, newborns delivered from a GDM mother had high risk of obesity and juvenile diabetes mellitus (DM) development. To our knowledge, there was no comparative study between conservative and multidisciplinary GDM management according to American Diabetes Association guidelines.

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Material and Method

A retrospective cohort study was conducted from October 2004 to September 2009 at Diabetes Mellitus Clinic, Thammasat University Hospital, Thailand. Pregnant women with GDM who were diagnosed from antenatal care clinic, Thammasat University Hospital were recruited. All medical record charts were reviewed. This study was approved by Thammasat University Hospital Ethical Committee.

Four hundred and two case record charts from pregnant women diagnosed with GDM during study period were enrolled. Participants were divided in

two groups. Conservative management group (CMG) composed of GDM cases that were diagnosed and managed per standard protocol during October 2004 to March 2007, Systematic management group (SMG) was GDM cases who were diagnosed and managed per a new standard protocol during April 2007 to September 2009.

Inclusion criteria in this study were GDM diagnosed in antenatal care clinic, Thammasat University Hospital, gestational age less than 36 weeks, continuously attended until delivery, DM clinic attention at least three visits in SMG, no underlying diseases and delivery at Thammasat University Hospital. Exclusion criteria were pregestational DM. After Four hundred and two case record charts review, CMG and SMG consisted of 87 and 118 cases, respectively.

The original standard protocol during October 2004 to March 2007 depended on an attending physician only. New standard protocol for a DM clinic was the multidisciplinary team approach. The DM care team was composed of an obstetrician, endocrinologist, diabetes nurse case manager (DNCM), nutritionist and pharmacologist. Management Guideline was based on the National Diabetes Data Group (NDDG)[9].

GDM screening was performed by a 50-gram glucose challenge test (GCT). Positive GCT were the cases which had blood sugar equal and more than 140 mg/dl after 1 hour of oral 50-gram glucose (Fig. 1).

One hundred gram oral glucose tolerance test (100-gram GTT) is the diagnostic test for GDM after positive GCT. Normal 100-gram GTT are the blood sugar value at fasting stage, 1, 2 and 3 hours after oral 100-gram glucose ingestion less than 105, 190, 165 and 145 mg/dl, respectively. When blood sugar is more than the normal level by at least two values, then GDM is diagnosed.

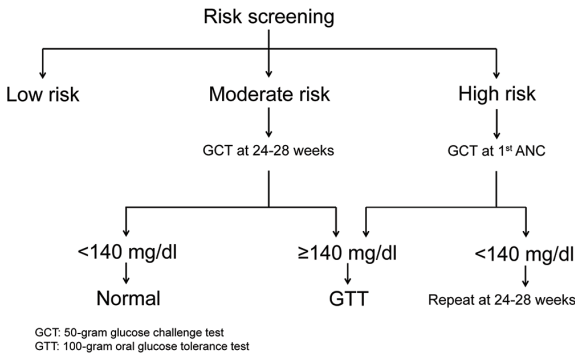

Fig. 1 Flow chart of diabetes mellitus screening in pregnancy.

GDM A1 is the GDM case that has normal levels of fasting blood sugar. GDM A2 is the case of GDM, which has fasting blood sugar equal and more than 105 mg/dl or 2 hours capillary blood sugar (CBG) after meal is equal or more than 120 mg/dl.

Systematic management is the tightly controlled diabetes treatment. GDM cases had counseling by DNCM and nutritionist for appropriate food amounts per day. Daily calories intake was calculated for each case. CBG was performed at least 3 times per day after or before meals in the first week. In case of failed diet control, the GDM was treated by insulin therapy under supervision of endocrinologist, nutritionist, DNCM and pharmacologist. Obstetrician had responsibility to monitor maternal and fetal wellbeing during antenatal care. DNCM plays a major role for continuously monitoring until delivery and postpartum period.

The goal of treatment was the normalization of blood sugar. Appropriate value of CBG before meals, 1 hour and 2 hours after meals were less than 95, 140 and 120 mg/dl, respectively.

A weekly appointment was applied for three consecutive visits in a new case and in cases of inappropriate blood sugar control. Two-week appointment was further applied in cases of well normalized blood sugar. After 36 weeks of gestational age, the appointment was one week in all cases.

Appropriate time and mode of delivery for GDM cases were managed per standard protocol under the supervision of an obstetrician who was board-certified for maternal fetal medicine. Demographic data, maternal and neonatal outcomes, antepartum, peripartum and postpartum results were reviewed.

Descriptive statistics were used for demographic data. The independent t-test and Chi-square were used to compare the difference between groups when appropriated. A *p*-value of less than 0.05 was considered significant. SPSS 17.0 (SPSS Inc., Chicago, USA) was the analysis software used.

Results

Medical records of 205 women who had diagnosed GDM were enrolled in the study. Neither group had any statistical demographic data differences. The demographic data were composed of age, body weight, height, prepregnant body mass index, oral glucose tolerance test (50 and 100-gram), parity and type of GDM (Table 1).

Maternal and neonatal outcomes were presented in Table 2. Neither group had any statistical differences in maternal and neonatal outcomes except CMG had a higher rate of neonatal hypoglycemia than SMG ($p = 0.007$).

Table 3 showed antepartum, peripartum and postpartum outcomes. Hospital admission more than 1 visit in CMG and SMG were 60.9 and 10.2 percent, respectively ($p<0.001$). Early DM clinic consultation (≤28 weeks of pregnancy) in CMG and SMG were

Table 1. Demographic data of GDM

	CMG (n = 87)	SMG (n = 118)	*p*-value
Age (year)*	33.20±5.30	32.60±4.60	0.39
Body weight (kg)*	64.40±11.90	61.80±17.30	0.45
Height (cm)*	155.80±5.20	156.50±5.90	0.58
Prepregnant BMI (kg/m^2)*	26.33±4.10	25.67±5.76	0.58
50-gram GCT*	193.00±43.00	189.00±38.00	0.59
100-gram GTT*			
0 hour	101.00±26.00	95.00±22.00	0.12
1 hour	223.00±43.00	214.00±39.00	0.16
2 hours	200.00±52.00	198.00±41.00	0.80
3 hours	166.00±54.00	155.00±40.00	0.13
GDM (%)			0.78
A1	37 (42.5)	53 (44.9)	
A2	50 (57.5)	65 (55.1)	
Parity (%)			0.14
Nulliparous	33 (37.9)	53 (44.9)	
Multiparous	54 (62.1)	65 (55.1)	

GDM = gestational diabetes mellitus; BMI = body mass index; GCT = glucose challenge test; GTT = oral glucose tolerance test; CMG = conservative management group; SMG = systematic management group
* Mean ± standard deviation

Table 2. Maternal and neonatal outcomes

	CMG (n = 87)	SMG (n = 118)	*p*-value
Composite maternal outcomes*	18 (20.7)	24 (20.3)	0.610
Cephalopelvic disproportion	7 (8.0)	12 (10.2)	0.410
Pregnancy induced hypertension	8 (9.2)	6 (5.1)	0.250
Postpartum hemorrhage	2 (2.3)	2 (1.7)	0.760
Fetal distress	1 (1.1)	4 (3.4)	0.300
Composite neonatal outcomes*	35 (40.2)	39 (33.1)	0.290
Hypoglycemia	9 (10.3)	2 (1.7)	0.007†
Jaundice	1 (1.1)	1 (0.8)	0.830
Intrauterine growth retardation	4 (4.6)	1 (0.8)	0.090
Intrauterine fetal death	1 (1.1)	0	0.240
Preterm (<37 weeks)	7 (8.0)	6 (5.1)	0.390
Macrosomia (≥4,000 grams)	8 (9.2)	7 (5.9)	0.380
LGA	26 (29.9)	32 (27.1)	0.640
APGAR 1 minute <7	2 (2.3)	2 (1.7)	0.760
Shoulder dystocia	1 (1.1)	0	0.240
Facial nerve palsy	1 (1.1)	0	0.240
Birth asphyxia	1 (1.1)	0	0.240
NICU admission	1 (1.1)	1 (0.8)	0.830

CMG = conservative management group; SMG = systematic management group; LGA = large for gestational at 90th percentile; NICU = newborn intensive care unit
† Statistical difference at $p<0.05$, * n (%)

Table 3. Antepartum, peripartum and postpartum outcomes

	CMG (n = 87)	SMG (n = 118)	*p*-value
Hospital admission	2**	1**	<0.001†
1	34 (39.1)	106 (89.8)	
≥2	53 (60.9)	12 (10.2)	
Gestational age at consultation			<0.001†
No	27 (31.0)	0	
≤28 weeks	23 (26.4)	69 (58.5)	
>28 weeks	37 (42.5)	49 (41.5)	
Mode of delivery			0.100
Vaginal delivery	37 (42.5)	37 (31.4)	
Obstetrics procedure	50 (57.5)	81 (68.6)	
Gestational age at delivery (weeks)			0.880
<38	25 (28.7)	34 (28.8)	
38-<40	57 (65.5)	79 (67.0)	
≥40	5 (5.8)	5 (4.2)	
Birth weight (gram)			0.190
≤3,500	60 (69.0)	91 (77.1)	
>3,500	27 (31.0)	27 (22.9)	
Appointment for 75-gram GTT*	22 (26.8)	103 (87.3)	<0.001†
Underwent 75-gram GTT*			<0.001†
No	68 (78.2)	65 (55.1)	
Yes	19 (21.8)	53 (44.9)	
Normal	7 (8.1)	29 (24.6)	
Impair GTT***	5 (5.7)	19 (16.1)	
DM	7 (8.1)	5 (4.2)	

CMG = conservative management group; SMG = systematic management group; GTT = oral glucose tolerance test; DM = diabetes mellitus

* n (%), ** Mode, *** Impair GTT = fasting plasma glucose 100-125 mg% or 2 hours GTT plasma glucose 140-199 mg%

† Statistical difference at $p<0.05$

26.4 and 58.5 percent, respectively ($p<0.001$). SMG had higher rates of postpartum 75-gram GTT appointments and attention rates than CMG ($p<0.001$). Other outcomes that presented in Table 3 were not different between both groups.

Discussion

This retrospective cohort study was conducted to evaluate the new management protocol. The original protocol based on standard guideline depending on the attending physician's judgment. This new protocol composed of standard guideline for treatment, patients counselling, tightly control of blood sugar, closed monitoring and multidisciplinary team approach. Results of this study showed no significant difference in maternal outcomes between conservative and systematic management. Cephalopelvic disproportion and pregnancy induced hypertension (PIH) were equal to both groups. These results differed from Landon et al work in 2009 that the PIH in tightly controlled was less than the conservative control[9]. Earlier work from Boriboonhirunsarn et al in 2006[10] found that postpartum hemorrhage (PPH) was a common maternal complication. In present study, the PPH rate was equal between the two groups. Rare events, confounding factors and demographic data change might play an important role. However, PIH and PPH in this study reduced from 9.2 to 5.1 ($p = 0.25$) and 2.3 to 1.7 ($p = 0.76$) percent, respectively. Low prevalence of PIH and PPH needed more samples for further study.

In the present study, SMG had prevalence of neonatal hypoglycemia less than CMG with statistical difference. This result showed to be consistent with the earlier work[10]. Macrosomia and large for gestational age (LGA) prevalence decreased but did not show statistical difference. This result may have been affected by low prevalence and that the previous protocol was standard management at that time. Preterm delivery, shoulder dystocia and obstetric

procedure were no different between CMG and SMG. Earlier work showed that LGA, macrosomia and obstetrics procedure rate decreased with statistical different[10].

Hospital admission of more than one visit in CMG was more than SMG, the percentages being 60.9 and 10.2, respectively (p<0.001). Early consultation (≤28 weeks of pregnancy) of CMG and SMG were 26.4 and 58.5%, respectively (p<0.001). This finding indicated that systematic management had decreased the number of hospitalization and increased early consultation. This result showed the important role of self-blood glucose monitoring and the multidisciplinary team approach. The limitations of this study was the lack of glycemic control and insulin usage data. The lower instances of complications in SMG were a consequence of tightly glycemic control and intensive fetal monitoring.

Mode of delivery, gestational age and birth weight of both groups showed similar results without statistical different. Postpartum for 75-gram GTT appointments had markedly increased from 26.8 to 87.3 percent. The percentage of postpartum diabetes surveillance of SMG was higher than CMG (44.9% vs. 21.8%, p<0.001). This finding indicated that the more postpartum diabetes surveillance appointment, the more postpartum diabetes surveillance was done.

In conclusion, systematic management of GDM by a multidisciplinary team approach combined with an appropriate guideline could reduce neonatal hypoglycemia and hospital admission included early consultation and postpartum diabetes surveillance increment.

What is already known on this topic?

GDM is one of the complications in both parturient and neonates. During antepartum period, pregnancy induced hypertension, preterm birth, fetal macrosomia, polyhydramnios and unexplained intrauterine fetal death were higher in GDM than normal pregnant women were. High blood sugar level in fetus induced fetal insulin secretion and pancreas hyperplasia. Macrosomia caused delivery difficulty, shoulder dystocia, increased cesarean section rate and neonatal hypoglycemia. As the long-term complication, newborn delivered from GDM mother had high risk of obesity and juvenile DM development. In Thailand, there was no comparative study between conservative and multidisciplinary GDM management according to American Diabetes Association guideline.

What this study add?

This finding indicated that the more postpartum diabetes surveillance appointment, the more postpartum diabetes surveillance was done. Systematic management of GDM by a multidisciplinary team approach combined with an appropriate guideline could reduce neonatal hypoglycemia and hospital admission included early consultation and postpartum diabetes surveillance increment.

Acknowledgement

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Potential conflicts of interest

None.

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ผลของการดูแลอย่างเป็นระบบในหญิงที่เป็นเบาหวานขณะตั้งครรภ์ต่อภาวะแทรกซ้อนในมารดาและทารก

พิชญ์วรา พันธุ์พิทย์แพทย์, ทิพาพร ธาระวานิช, จรินทร์ทิพย์ สมประสิทธิ์, ชำนาญ แท่นประเสริฐกุล, คมสันติ์ สุวรรณฤกษ์

วัตถุประสงค์: *เพื่อศึกษาเปรียบเทียบภาวะแทรกซ้อนของมารดาและทารกในหญิงที่เป็นเบาหวานขณะตั้งครรภ์ ระหว่างการดูแลแบบดั้งเดิมและการดูแลอย่างเป็นระบบ*

วัสดุและวิธีการ: *เป็นการศึกษาย้อนหลังในโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ หญิงที่เป็นเบาหวานขณะตั้งครรภ์ที่ได้รับการวินิจฉัยและรักษา ถูกแบ่งเป็นสองกลุ่ม กลุ่มควบคุมประกอบด้วยหญิงที่เป็นเบาหวานขณะตั้งครรภ์ที่ได้รับการวินิจฉัยและรักษาระหว่างเดือนตุลาคม พ.ศ. 2547 จนถึง มีนาคม พ.ศ. 2550 ได้รับการรักษาตามมาตรฐานการรักษาโรคเบาหวานในขณะนั้น ในขณะที่กลุ่มศึกษาประกอบด้วยหญิงที่เป็นเบาหวานขณะตั้งครรภ์ที่ได้รับการวินิจฉัยและรักษาระหว่างเดือนเมษายน พ.ศ. 2550 จนถึง กันยายน พ.ศ. 2552 จะได้รับการรักษาโรคเบาหวานตามมาตรฐานแบบใหม่โดยทีมสหสาขาวิชาชีพ ประกอบด้วยแพทย์ พยาบาลผู้จัดการรายกรณีผู้ป่วยเบาหวาน นักโภชนาการ และเภสัชกร*

ผลการศึกษา: *มีผู้ป่วยจำนวน 87 และ 118 ราย ในกลุ่มควบคุมและกลุ่มศึกษาตามลำดับ อายุเฉลี่ยและดัชนีมวลกายก่อนการตั้งครรภ์ของทั้งสองกลุ่มไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ผลการตรวจระดับความทนน้ำตาลกลูโคส 50 และ 100 กรัม ในทั้งสองกลุ่มไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ อุบัติการณ์ของโรคเบาหวานขณะตั้งครรภ์ชนิดเอสอง เท่ากับร้อยละ 57.5 และ 55.1 ในกลุ่มควบคุมและกลุ่มศึกษาตามลำดับ อายุครรภ์ขณะส่งปรึกษาคลินิกเบาหวานและจำนวนครั้งการนอนโรงพยาบาลในกลุ่มศึกษาน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ การเกิดภาวะน้ำตาลในเลือดต่ำของทารกแรกคลอดในกลุ่มศึกษาน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ (ร้อยละ 1.7 และ 10.3 ตามลำดับ) การนัดหมายมารดาหลังคลอดเพื่อตรวจระดับความทนน้ำตาลกลูโคส 75 กรัม และร้อยละของมารดาหลังคลอดที่มารับการตรวจระดับความทนน้ำตาลกลูโคส หลังคลอด 75 กรัม ในกลุ่มศึกษามากกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ภาวะแทรกซ้อนอื่น ๆ ในมารดาและทารกของกลุ่มศึกษาและกลุ่มควบคุมไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ*

สรุป: *การดูแลอย่างเป็นระบบโดยทีมสหสาขาวิชาชีพตามมาตรฐานการรักษา มีผลลดอัตราการเกิดภาวะน้ำตาลในเลือดต่ำของทารกแรกเกิด ลดจำนวนครั้งของการนอนโรงพยาบาล และเพิ่มอัตราการตรวจคัดกรองเบาหวานหลังคลอด*