Association of intrapartal maternal blood glucose control and neonatal hypoglycemia in a private tertiary hospital*

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ABSTRACT

Objective: Diabetes in pregnancy is associated with maternal and fetal risks that include maternal hyperglycemia and neonatal hypoglycemia. Intrapartal plasma glucose concentration has a stronger association with decreased neonatal hypoglycemia paralleled with antepartum plasma glucose levels. The objective of the study is to determine the association between intrapartal glucose monitoring and neonatal hypoglycemia.

Methods: This is a retrospective cohort study that involves parturients of any age with term gestation (≥37 weeks) with gestational type or overt type of diabetes mellitus, either insulin-requiring or on medical nutrition therapy, with or without mean capillary blood glucose levels during labor. Multiple logistic regression was used for analysis, which quantifies the magnitude of association between maternal blood glucose control and neonatal hypoglycemia adjusted for significant confounders.

Results: The incidence of diabetes among pregnants in this private tertiary hospital over the study period was 7.82%. Most of the diabetic parturients were primigravid, with gestational type of diabetes mellitus, and on medical nutrition therapy. More than half were referred to an endocrinologist intrapartum. The incidence of maternal hyperglycemia intrapartum is 33%. The birthweights of the neonates ranged from 2095 to 5250 grams. Among the diabetic parturients, the incidence of neonatal hypoglycemia is 10%. There was no significant association between neonatal hypoglycemia and intrapartummaternal hyperglycemia (p=0.05).

Conclusion: There is no significant association between intrapartum maternal hyperglycemia and development of neonatal hypoglycemia. Antepartum and intrapartum management of maternal hyperglycemia did not appear to be associated with the development of neonatal hypoglycemia. A standardized institutional management protocol on glucose monitoring and control among diabetic parturients is strongly suggested.

Keywords: diabetes in pregnancy, intrapartum blood glucose monitoring, neonatal hypoglycemia

INTRODUCTION

According to the Philippine Obstetrical and Gynecological Society (POGS) Clinical Practice Guidelines (CPG) on Diabetes Mellitus in Pregnancy, diabetes during pregnancy is classified as either gestational diabetes mellitus (GDM) or overt diabetes mellitus based on plasma glucose levels. Universal screening for GDM is recommended for Filipino gravidas. The prevalence of GDM in the Philippines based on the Association of South East Asian Nations (ASEAN) Study Group on Diabetes in Pregnancy (ASGODIP) is 3-4% in low-risk patients but 38% prevalence rate in the high-risk group. Filipino gravidas are considered "high risk" by race or ethnicity for type 2 diabetes mellitus and should be screened on their first prenatal visit either by fasting blood sugar (FBS) or glycosylated hemoglobin (HbA1c) or random blood sugar (RBS) or 75 grams oral glucose tolerance test (OGTT). During the POGS CPG Concensus Meeting, it was agreed that Filipinos are among the high risk groups for developing type 2 diabetes mellitus with prevalence rates estimated to be between 8-10%.[1]

Diabetes in pregnancy is associated with a number of maternal and fetal risks, and many of these occur intrapartum and postpartum.[2] Intensive management is associated with decrease in morbidity and mortality in infants. Neonatal morbidities include macrosomia, hypoglycemia, hyperbilirubinemia, polycythemia and poor feeding.[3]

Hypoglycemia is a metabolic problem common in neonatal medicine. Majority of healthy neonates observed with low blood glucose concentrations are not related to any significant problem and may only reflect normal processes of metabolic adaptations to extrauterine life. Low blood glucose in the first postnatal days that are prolonged and recurrent may result to acute systemic effects and neurologic sequelae. Thus, management of low blood glucose in the first postnatal days assumes considerable focus in newborn care worldwide.[4] Neonatal hypoglycemia was defined as blood glucose level <50 mg/dL according to S.T.A.B.L.E. Program.[5] Clinical manifestations of a neonate with low blood glucose includes tremor, sweating lethargy, floppiness,

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coma and seizures and the level of glucose at which the manifestations occurred determined a working definition for significant hypoglycemia. Since similar manifestations can occur with other neonatal problems such as perinatal asphyxia, sepsis or other metabolic abnormalities, the prerequisite for the diagnosis of significant neonatal hypoglycemia must satisfy Whipple's triad which includes 1) the presence of characteristic clinical manifestation, 2) coincident with low plasma glucose concentrations measured accurately with sensitive and precise methods, and 3) that clinical signs resolve within minutes to hours once normoglycemia has been reeastablished.[4]

According to the United Kingdom's National Service Framework for Diabetes, neonatal hypoglycemia occurs in approximately 24% of babies.[6] Based on local studies in tertiary hospitals, Espiritu-Dolendo and Trapaga (1995) and Lahoz, Isleta and Abad (1995) revealed that 21.7% and 28.4%, respectively, of infants of diabetic mothers had hypoglycemia.[7,8] In a study by Barret and company, in 137 singleton, term deliveries of diabetic women, the incidence of neonatal hypoglycemia was 22%. About 87% of those neonates with hypoglycemia were born from mothers with blood glucose levels of 4-8 mmol/L, which is almost considered controlled maternal glucose levels in some studies.[9]

Glucose is the essential substrate for brain function. While important at all ages, it is particularly so in childhood because a normal supply is needed to protect neural development.[10] Infants born at term undergo a period of metabolic transition to the extrauterine environment; hence transient low plasma glucose levels are common. During the first 2 hours of postnatal life, there is a decline in plasma glucose levels followed by a rise, reaching a steady state glucose concentration by 2 to 3 hours after birth.[4] Hypoglycemia in association with acute neurologic dysfunction and long-term neurodevelopmental impairment is significant in a minority of neonates. Individual susceptibility to brain injury varies founded on factors such as gestational age, type and volume of early milk feedings, presence of comorbid conditions and ability of the infant to produce and to use alternative cerebral fuels, therefore there is no universally accepted "safe" blood glucose level for newborns.[11]

Several studies have shown that particular attention to avoiding maternal hyperglycemia during labor can prevent neonatal hypoglycemia. In a study done by Curet et al, which involved 233 insulin-requiring diabetics who received intensive diabetic treatment, infants of patients who had lowest mean antepartum and intrapartum plasma glucose levels were found to have the lowest incidence of neonatal hypoglycemia. The study also found that patients with low mean intrapartum plasma glucose concentration had a stronger association with decreased neonatal hypoglycemia when paralleled with the low mean antepartum plasma glucose levels. Their conclusion was even on the background of poor antepartum diabetic control, tight regulation of plasma glucose levels during the intrapartum period would significantly reduce the incidence of neonatal hypoglycemia. In this study, "tight control" was defined as maintaining the intrapartum glucose level <100 mg/dL and postprandial plasma glucose level <150 mg/dL.[12] Balsells, Corcoy, Adelantado et al, in a similar study, concluded that use of a standardized intrapartum management protocol in women with gestational diabetes mellitus is associated with fair metabolic control. In this study, their protocol includes the following: 1) an IV glucose infusion (8.3g/hr) since arrival to the obstetric ward, 2) a parallel IV regular insulin infusion by syringe pump adjusted according to hourly CBC measurements and 3) urine test for ketone bodies. Likewise, "fair metabolic control" was defined as maintaining CBG values within the target range of 2.8-6.9 mmol/l (ideally 3.3-6.1 mmol/l) and to avoid ketonuria. They also concluded that insulin requirements during labor are unrelated to therapy during the antepartum period and that high capillary blood glucose during labor increases the risk of neonatal hypoglycemia.[14] In the study by Quintero, Istwan and Rhea et al, a suboptimal glycemic control defined as blood glucose averages more than the guidelines set by the American College of Obstetricians and Gynecologists: mean fasting blood glucose ≥95 mg/dL, mean 1-hour postprandial of ≥140 mg/dL, or mean 2-hour postprandial of ≥120 mg/dL in women with gestational diabetes mellitus is associated with adverse neonatal outcomes, which includes neonatal hypoglycemia and macrosomia.[16] According to the POGS CPG on Diabetes Mellitus in Pregnancy, plasma glucose monitoring is every 1-4 hours with target of control at plasma glucose 80-120 mg/dL or capillary glucose 70-110 mg/dL. A short acting insulin via infusion at a dose of 0.5-1 unit per hour is given for plasma glucose above 120 mg/dL.[1]

To date, there have been few studies locally that have analyzed the association of maternal glycemic control during labor and development of neonatal hypoglycemia with the last update during 1990s. An intrapartum management protocol for diabetic patients can be formulated to keep maternal glycemia at all times to prevent neonatal hypoglycemia.

OBJECTIVES

General Objectives

The purpose of the study is to determine the association between intrapartum glucose control of

diabetic parturients and the development of neonatal hypoglycemia in a private tertiary hospital over January 2010 to January 2015.

Specific Objectives

1. To determine the incidence of diabetes among women who delivered in this institution during the study period
2. To describe the maternal characteristics, antepartum and intrapartum management of diabetic parturients
3. To determine the incidence of intrapartum maternal hyperglycemia among diabetic parturients
4. To describe the characteristics of neonates born to diabetic parturients
5. To determine the incidence of neonatal hypoglycemia among diabetic parturients
6. To determine the proportion of neonates with hypoglycemia among mothers with and without intrapartum hyperglycemia
7. To determine the maternal and neonatal factors associated with the development of neonatal hypoglycemia

MATERIALS AND METHODS

Study Design

This is a retrospective cohort study undertaken to determine the relationship between the development of neonatal hypoglycemia and intrapartal blood glucose control among diabetic parturients from January 2010 to January 2015.

Patient Population

The study population included term parturients of any age, with gestational age of at least 37 weeks with gestational or overt diabetes mellitus, diagnosed during prenatal period by the recommended screening tests by the POGS, who delivered in any manner at a private tertiary hospital from January 2010 to January 2015.

Sample size and power calculation

Epi Info StatCalc and PASS 2008 software were used to compute the minimum sample size for the study. Parameters for the computation were based on previous published literature.[7,16]

The rule for determining the minimum sample size requirement for a given study is to calculate it based on each quantitative objective of the study. The largest sample size computed should be the minimum number of participants.

The largest sample size of 4926 patients will satisfy all the study objectives. The computations of sample size for each of the objectives are summarized in the succeeding paragraphs and tables.

For Objective 1, a minimum of 113 diabetic pregnant women per year are needed in order to achieve a 95% level of confidence, precision of 5% given an incidence of 21.7% (Dolendo and Trapaga, 1995)[7] and a finite population of 200.

For objective 3, the proportion of diabetic parturients with hyperglycemia will be computed as follows:

$$P = \frac{\%\ \text{of diabetic parturients with hyperglycemia}}{\text{total \# of diabetic parturients from January 2010 to January 2015}}$$

For objective 5, the proportion of neonatal hypoglycemia among diabetic parturients will be computed as follows:

$$P = \frac{\%\ \text{of infants with neonatal hypoglycemia among diabetic parturients (January 2010 to January 2015)}}{\text{total \# of infants of diabetic parturients from January 2010 to January 2015}}$$

Inclusion Criteria

Term parturients with diabetes mellitus diagnosed by a licensed physician who have undergone screening tests recommended by the POGS were included in the study. Diabetic parturients may be insulin-requiring or on medical nutrition therapy, with or without antepartal glucose control. The population also included parturients of any age and parity with other co-morbidities such as hypertension, dyslipidemia, obesity, thyroid disorders and other metabolic conditions. Likewise, the diabetic parturients may or may not have determinations of capillary blood glucose during her stay in the labor room.

Exclusion Criteria

Parturients with preterm gestation (less than 37 weeks age of gestation) on admission, multifetal pregnancy and diagnosed fetal congenital anomaly were excluded in the study as well as those who did not go through first stage labor in the hospital which includes imminent delivery upon consult at the pre-labor room. Patients who are diabetic who came in for elective cesarean section were also excluded.

Operational Definition and Study Variables

Parturient is a pregnant woman enduring the process of labor. Diabetes in pregnancy is either gestational diabetes mellitus (GDM) or overt diabetes mellitus based on plasma glucose levels. *Maternal hyperglycemia* was defined as occurrence of plasma glucose level >126mg/dL (7 mmol/l).[14] *Controlled intrapartal glucose level* was defined as glucose levels 72-126 mg/dl (4-7 mmol/l)[9,14], while *uncontrolled intrapartal glucose levels* as glucose levels >126 mg/dL (7 mmol/l).[14]

Neonatal hypoglycemia was defined as capillary blood glucose level less than 50 mg/dL for at least 2 occurrences corrected with use of 10% dextrose water drip or bolus or feeding with milk formula or breast milk to alleviate hypoglycemia to blood glucose level to more than or equal to 50 mg/dL.[4] Characteristic signs of neonatal hypoglycemia may manifest as tremor, sweating, lethargy, poor suck, floppiness, coma and seizures as observed by the pediatrician.

Statistical Analysis

The primary investigator used MS Excel for coding and encoding of data and checking for missing values, inconsistencies, keypunching errors, miscoded or inadmissible data. The data set in MS Excel format was then converted to a Stata data file using the Stat Transfer program. Stata/SE Version 12 for Windows was utilized to process and prepare the data for further analysis. Stata/SE Version 12 was used for both the descriptive and inferential statistics.

Multiple logistic regression was used to generate the odds ratio (an estimate of the risk ratio) which quantifies the magnitude of association between maternal blood glucose monitoring and neonatal hypoglycemia adjusted for significant confounders.

RESULTS

During the study period, there were 12,380 deliveries. Of the 12,380 deliveries, 968 were diabetic, giving an incidence of 7.82%. From the total number of diabetics who delivered during the study period, 476 diabetic parturients satisfied the inclusion criteria and were included in the study.

Table 1 shows antepartum and intrapartum clinical characteristics of study population. The average age of patients is 31.91 years with an age range of 18 to 46 years old. The mean gravidity is 1.82 (range: 1-7) and parity is 0.67 (range: 0-6). The average age of gestation on admission is 38.74 (range: 37-41.86). Sixty five percent (n=308) of the patients underwent normal spontaneous delivery while 168 (35%) underwent abdominal delivery. Four hundred fifty eight diabetic parturients (96%) had gestational diabetes mellitus and only 18 (4%) had overt diabetes. Antepartum management of these diabetic parturients show that seventy one percent (n=338) of the patients were on medical nutrition therapy alone and 138 (29%) were on insulin therapy.

The same table (Table 1) shows the intrapartum characteristics of diabetic parturients. Only 284 (60%) of the diabetic patients were referred to an endocrinologist while the 192 (40%) were managed by the obstetrician alone. Of the 476 subjects, 148 (31%) did not have glucose determination and were excluded in the study, leaving 328 subjects for inclusion in further data analysis. Of the 328 subjects, 107 (33%) developed hyperglycemia during labor. Of the 328 subjects, 24 (5%) required insulin administration intrapartum. The capillary blood glucose (CBG) levels of

Table 1. Antepartum and Intrapartum Characteristics of Study Population (n=476)

	N (%)
Maternal Characteristics	
Maternal age (in years), mean	31.91 ± 4.28 (18 - 46)
Gravidity, mean	1.82 ± 1.12 (1 - 7)
Parity, mean	0.67 ± (0 - 6)
Age of gestation, mean	38.74 ± 0.98 (37 - 41.86)
Manner of delivery	
Normal spontaneous delivery	308 (65)
Primary cesarean section	168 (35)
Diabetes Mellitus	
Overt	18 (4)
Gestational	458 (96)
Antepartum insulin use	
Yes	138 (29)
Medical nutrition therapy alone	338 (71)
Intrapartum referral to endocrinologist	
Yes	284 (60)
No	192 (40)
Frequency of intrapartum CBG monitoring	
No glucose determination[a]	148 (31)
Baseline determination alone	107 (22)
Every hour	12 (3)
Every 2 hours	5 (1)
Every 4 hours	204 (43)
Hyperglycemia during labor[a]	
Yes	107 (33)
No	221 (67)
Insulin administration during labor[a]	
Yes	24 (7)
No	304 (93)
Capillary blood glucose reading (in mg/dl), mean[b]	106.16 ± 19.30 (65- 219)

[a] No data on hyperglycemia during labor and exluded in further analysis
[b] 148 patients have no data on average cbg/no monitoring was done

Table 2. Intrapartum Management of Hyperglycemia (n=328)

MEDICAL NUTRITION THERAPY (n=203)			
Hyperglycemia during labor	**Insulin administration during labor**		**Total**
	With	**Without**	
With	7 (11)	54 (89)	61 (100)
Without	1 (1)	141 (99)	142 (100)
TOTAL	8 (4)	195 (96)	203 (100)
INSULIN-REQUIRING (n=125)			
Hyperglycemia during labor	**Insulin administration during labor**		**Total**
	With	**Without**	
With	13 (28)	33 (72)	46 (100)
Without	3 (4)	76 (96)	79 (100)
TOTAL	16 (13)	109 (87)	125 (100)

these subjects during labor ranged from 65 to 219 mg/dL with an average of 106.16 mg/dL. The distribution of frequency of glucose monitoring is as follows: 107 (22%) had baseline glucose determination alone, 12 (3%), 5 (1%), and 204 (43%) had glucose determination every 1, 2, and 4 hours, respectively.

Table 2 shows the intrapartum management of hyperglycemia. Of the 328 diabetic parturients, 203 (85%) were on antepartum medical nutrition therapy alone. Of these, 61 (30%) developed hyperglycemia intrapartum and 7 eventually required insulin during labor. Seventy percent (n=142) did not develop hyperglycemia but one was given insulin. Of the 328 diabetic parturients, 125 (15%) were already insulin-requiring antepartum. Only thirty seven percent (n=46) of these developed hyperglycemia during labor. Among the 79 (63%) insulin-requiring parturients who did not develop hyperglycemia, 3 (4%) were given routine insulin administration.

Table 3 shows the outcome of neonates of all diabetic parturients who delivered in this institution during the study period. The birth weights ranged from 2095 to 5250 grams with a mean of 3112.37 grams. Of these, 43 (9%) are considered to be large-for-gestational age. Three out of 476 (1%) experienced hypoglycemic symptoms; 2 had jitteriness and 1 had poor suck. Out of the 476 neonates, 62 (13%) did not have glucose determination and were excluded in further analysis. The mean glucose levels of the remaining 414 neonates ranged from 29 to 205 mg/dL with an average of 65.51 mg/dL.

There were 43 neonates who developed hypoglycemia giving an incidence of 10%. Of the 43 hypoglycemic neonates, 36 (84%) were given feeding while 7 (16%) were given 10% dextrose in water.

We sought to determine the relationship of intrapartum maternal hyperglycemia with the development of neonatal hypoglycemia (Table 4). Of the 43 neonates

Table 3. Outcome of Neonates of Diabetic Parturients(n=476)

	N (%)
Neonatal Characteristics	
Pediatric aging (in weeks), mean	38.60 ± 0.85 (37 - 41)
Birthweight (in grams), mean	3112.37 ± 398.50 (2095 - 5250)
Birthweight classification	
Small-for-gestational age	4 (1)
Appropriate-for-gestational age	429 (90)
Large-for-gestational age	43 (9)
HGT, mean[c]	65.51 ± 12.94 (29 - 205)
Presence of hypoglycemia symptoms	
Yes	3 (1)
No	473 (99)
Specific treatment for hypoglycemic neonates	
Feed	36 (84)
D10W	7 (16)

[c] *Sixty two neonates did not have glucose monitoring and were excluded in analysis*

Table 4. Relationship between Intrapartum Maternal Hyperglycemia and Development of Neonatal Hypoglycemia

	Neonatal Hypoglycemia		p-value
	Without hypoglycemia	With Hypoglycemia	Total
Without maternal hyperglycemia	177 (67)	23 (85)	X^2=3.75 P=0.05*
With maternal hyperglycemia	87 (33)	4 (15)	

with hypoglycemia, only 27 were delivered from mothers who have had intrapartum glucose monitoring and were included in this subset analysis. Of these 27 neonates with hypoglycemia, only 4 (15%) were born from mothers with intrapartum hyperglycemia and 23 (85%) were born from mothers with good intrapartum glucose control. Notably, 87 (33%) neonates of mothers with intrapartum hyperglycemia did not develop hypoglycemia. This difference was found to be not statistically significant (P=0.05)

Simple logistic regression was used to assess potential confounders that can be included in the full model. Model building was done to produce the adjusted odds ratio. Since the prevalence of neonatal hypoglycemia in this study is only 10%, the odds ratio produced is a good estimate of the risk ratio. However, after controlling for the effect of hyperglycemia during labor, no significant association was observed between intrapartal glucose monitoring and neonatal hypoglycemia (p=0.47) (Table 5). No other significant association between neonatal hypoglycemia and other maternal characteristics were found.

DISCUSSION

The 7.82% incidence of diabetes among parturients who delivered in this institution during the study period was consistent with the data of POGS.[1] Our study population is relatively young, predominantly primigravid with gestational diabetes mellitus, and were mostly managed with medical nutrition therapy. Majority of the parturients in the study had gestational type of diabetes mellitus, which was similar to the previous researches[7,8,17]. The incidence of intrapartum maternal hyperglycemia in our institution was found to be 22%, again similar to those found in other studies. With regards to blood glucose monitoring during labor, there appears to be no consensus in this institution, with frequency of glucose monitoring ranging from baseline determination alone

Table 5. Crude and adjusted logistic regression models of neonatal hypoglycemia and intrapartal glucose monitoring [a]

	Neonatal hypoglycemia			
	Crude		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Maternal age	0.98 (0.91 - 1.05)	0.52	NOT INCLUDED IN THE FULL MODEL	
Gravidity	1.01 (0.76 - 1.34)	0.94	NOT INCLUDED IN THE FULL MODEL	
Parity	0.97 (0.71 - 1.34)	0.87	NOT INCLUDED IN THE FULL MODEL	
Age of gestation on delivery	0.91 (0.67 - 1.25)	0.58	NOT INCLUDED IN THE FULL MODEL	
Manner of delivery	0.71 (0.36 - 1.40)	0.32	NOT INCLUDED IN THE FULL MODEL	
Type of diabetes	0.86 (0.19 - 3.91)	0.85	NOT INCLUDED IN THE FULL MODEL	
Antepartum insulin requirement	1.27 (0.65 - 2.47)	0.48	NOT INCLUDED IN THE FULL MODEL	
Intrapartum referral to endocrinologist	1.40 (0.74 - 2.65)	0.30	NOT INCLUDED IN THE FULL MODEL	
Intrapartum maternal hyperglycemia	0.35 (0.12 - 1.05)	0.06*	0.39 (0.12 - 1.20)	0.10
Intrapartum Insulin administration	0.72 (0.20 - 2.54)	0.61	NOT INCLUDED IN THE FULL MODEL	
Pediatric aging	1.00 (0.69 - 1.46)	0.98	NOT INCLUDED IN THE FULL MODEL	
Birthweight	1.00 (0.999-1.0)	0.92	NOT INCLUDED IN THE FULL MODEL	

[a] Adjusted for the effect of hyperglycemia during labor

to as often as every hour to every 4 hours. The latest POGS clinical practice guidelines recommend monitoring of blood glucose levels every 1 to 4 hours during labor. With regards to intrapartum insulin administration, the current local recommendation is short acting insulin administration when the blood glucose level reaches 120mg/dL or more. In this institution, there appears to be no consistent protocol on insulin administration during labor. Of note, some subjects with intrapartum hyperglycemia did not receive insulin at all while a few were given routine insulin administration in the absence of hyperglycemia. This difference in intrapartum glucose management of diabetic parturients may be related to the differences in individual practices of the clinicians. However, in light of the evidence showing that poor maternal intrapartum glucose control may lead to adverse neonatal outcomes, a standardized institutional protocol for intrapartum management of diabetic parturients may prove to be beneficial to our patients.

The majority of infants born to diabetic mothers in this institution appear to have birth weights appropriate for gestational age. The incidence of large for gestational age neonates was found to be 9%. Whether or not this is related to good anterpartum glucose control is beyond the scope of our study but it would be worthwhile to explore this association in future studies. According to some studies, suboptimal glycemic control had higher incidence of macrosomia and large-for-gestational-age neonates.[16]

The incidence of neonatal hypoglycemia among diabetic parturients in this study was found to be 10%, lower than that found in literature. We did not find any maternal antepartum or intrapartum characteristics that are significantly associated with the development of neonatal hypoglycemia. The method of antepartum diabetic management did not appear to be related to the development of neonatal hypoglycemia. Neither is the presence of intrapartum maternal hyperglycemia significantly associated with hypoglycemia in the neonate. Our hypothesis is that intrapartum maternal hyperglycemia will contribute to the development of neonatal hypoglycemia. However, contrary to other studies, our results show no statistically significant association between presence of intrapartum maternal hyperglycemia and subsequent development of neonatal hypoglycemia. Of note however is our finding of neonatal hypoglycemia among mothers who did not develop hyperglycemia intrapartum.

Hypoglycemia in infants of diabetic mothers is influenced by factors such as prior maternal glucose homeostasis and maternal glycemia intrapartum. Inadequate glycemic control in pregnant diabetics would stimulate the fetal pancreas to synthesize excessive insulin causing fetal hyperinsulinemia, which can cause diminished hepatic glucose production in neonates. Also, intravenous dextrose administration during the intrapartal period can result in maternal hyperglycemia, which can exaggerate the infant's normal fall in plasma glucose concentration postdelivery. Another factor would be defective counterregulation by catecholamines and glucagon. In particular interest with the sympathoadrenal neural axis wherein there is urinary excretion of catecholamines. The hypoglycemia after birth is secondary to adrenal exhaustion from exposure to excessive quantities of glucose.[18]

Limitations

The primary limitation of this study is in the sample size. A post-hoc power analysis showed that a sample size of 476 observations achieves 23% power at a 0.05 significance level to detect a change in Prob (Y=1) from the baseline value of 0.082 to 0.120. Therefore, due to the low statistical power caused by low sample size, it is highly likely that a false negative association was observed between intrapartal glucose monitoring and neonatal hypoglycemia. Thus, further studies with higher sample size are therefore recommended. Another limitation would be that various practitioners managed these patients with differing clinical practices on intrapartum management.

CONCLUSION AND RECOMMENDATIONS

The incidence of diabetes among women who delivered in this institution during the study period was 7.82%. Majority of the diabetic parturients were relatively young, mostly primigravid, with gestational type of diabetes mellitus, and on antepartum medical nutrition therapy. More than half of the diabetic parturients was referred to an endocrinologist intrapartum, while the rest was managed by the obstetrician. Almost one third of the diabetic parturients developed hyperglycemia intrapartum and only a few of them required insulin during labor. Majority of the diabetic parturients did not develop hyperglycemia but one was given insulin. Among the insulin-requiring diabetic parturients, one third developed hyperglycemia during labor. A handful of the insulin-requiring diabetic parturients who did not develop hyperglycemia were given routine insulin administration. The incidence of intrapartum maternal hyperglycemia among diabetic parturients was 33%.

Most of the neonates born from diabetic parturients had birth weights that were appropriate for gestational age. Only a small percentage (<1%) of the neonates developed hypoglycemic symptoms such as jitteriness and poor suck. The incidence of neonatal hypoglycemia among diabetic parturients is 10% in this study. Among neonates with hypoglycemia, majority was delivered from mothers

without hyperglycemia. Also, most of the mothers with hyperglycemia intrapartum delivered to neonates without hypoglycemia. This study did not find any maternal antepartum and intrapartum characteristics, which can significantly associate with development of neonatal hypoglycemia. Likewise, antepartum and intrapartum management of maternal hyperglycemia did not appear to be related to the development of neonatal hyporglycemia. Finding of neonates with hypoglycemia that were born from mothers who did not develop hyperglycemia intrapartum could be due to other maternal and neonatal factors which was not part of the scope of the study such as antepartum glycemic control, intravenous dextrose administration during intrapartal period and secondary adrenal exhaustion from exposure to excessive quantities of glucose among the neonate.

Further studies with larger sample size, possibly including inter-hospital data, may produce different results, and are therefore recommended.

There appears to be no standardized intrapartum management of diabetic parturients in this institution. Therefore, a standardized institutional management protocol on glucose monitoring and control among diabetic parturients is strongly suggested. ■

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