Fetal macrosomia greater than or equal to 4000 grams

Comparing maternal and neonatal outcomes in diabetic and nondiabetic women

Ahmed M. Saleh, *MD, FRCSC,* ***Sultan M. Al-Sultan,*** *MD,* ***Anwar M. Moria,*** *MD,* ***Fatema I. Rakaf,*** *MD,*
Yasmin M. Turkistani, *MD,* ***Shaha H. Al-Onazi,*** *MD.*

ABSTRACT

الأهداف: مقارنة النتائج لدى الأمهات والمواليد في حالات تضخم الأجنة في الحوامل بسكري وبدون سكري.

الطريقة: تمت دراسة الحالات بأثر رجعي في مستشفى القوات المسلحة – الرياض – المملكة العربية السعودية، خلال الفترة مابين يناير 2004م وحتى ديسمبر 2006م. شملت الدراسة 766 حالة مولود متضخم الوزن طابقت شروط الدخول في الدراسة. تمت مقارنة المواصفات والنتائج في الأمهات والمواليد بين المجموعتين: الحوامل مع السكري (207 حالة)، الحوامل بدون سكري (559 حالة).

النتائج: كان هناك الكثير من المواليد اللذين يعانون من تضخم في الوزن من أمهات حوامل بدون السكري (73%) مقابل (27%) في الحوامل مع السكري ($p<0.001$). كانت الولادة القيصرية في الحوامل مع سكري بالمقارنة مع الحوامل بدون سكري (30.4%) مقابل (19.5%) ($p=0.002$). لم يكن هنالك أي فروقات إحصائية بين المجموعتين من حيث الحمل المرضي (12.6%) مقابل (14.1%) ($p=0.7$). كان هناك حالات أشد خطورة، من حيث تعضل ولادة الكتف في مواليد أمهات سكري مقارنة بأمهات بدون سكري (1.9%) مقابل (0.2%) ($p=0.03$).

خاتمة: إن الولادة القيصرية المخطط لها في الحمل ذو الوزن المقدر بـ4500g أو أكثر في الحوامل بدون سكري ووزن مقدر بـ4250 أو أكثر في الحوامل بسكري، من الممكن أن يساعد على تجنب حالات عسر ولادة الكتف دون أن يزيد درجة المضاعفات في الأمهات.

Objective: To compare maternal and neonatal outcomes of fetal macrosomia in diabetic and nondiabetic women.

Method: A retrospective case-control study was conducted at Riyadh Military Hospital, Riyadh, Kingdom of Saudi Arabia from January 2004 to December 2006. A total of 766 macrosomic newborns met the inclusion criteria. We compared maternal and neonatal characteristics and outcomes between diabetic (group 1, n=207) and nondiabetic (group 2, n=559) women.

Results: There were significantly more macrosomic newborns in nondiabetic women; 73% versus 27% in diabetic women, $p=0.0001$. Cesarean deliveries were significantly higher in diabetic women compared to nondiabetic women (30.4% versus 19.5%, $p=0.002$). There were no significant differences between either group in total maternal morbidity (12.6% versus 14.1%, $p=0.7$). There were significantly more severe cases of shoulder dystocia occurring in newborns of diabetic women compared to nondiabetic women (1.9% versus 0.2%, $p=0.03$).

Conclusion: Elective cesarean delivery for estimated fetal weight ≥4500g for nondiabetic women and ≥4250 g for diabetic women may avoid severe shoulder dystocia without increasing maternal morbidity rates.

Saudi Med J 2008; Vol. 29 (10): 1463-1469

From the Department of Obstetrics and Gynecology, Riyadh Military Hospital, Riyadh, Kingdom of Saudi Arabia.

Received 9th June 2008. Accepted 2nd September 2008.

Address correspondence and reprint request to: Dr. Ahmed Saleh, Department of Obstetrics and Gynecology, Riyadh Military Hospital, Riyadh, Kingdom of Saudi Arabia. Tel. +966 (1) 454 4031 . Fax. +966 (1) 453 7462 . E-mail: drsaleh99@yahoo.com

Diabetes complicates 2-6% of pregnancies.[1,2] Complications arising during pregnancy vary according to the type of diabetes (pregestational or gestational), and the glycemic control. Thus, pregestational diabetes when it is well controlled in early pregnancy can minimize the incidence of diabetes related congenital anomalies.[3] Whereas diabetic control late in pregnancy can affect body composition (macrosomias), the metabolic status (hypoglycemia, hypocalcemia) and respiratory function (respiratory distress syndrome).[4,5] Previous studies reported that perinatal mortality has

15Fetalmacro20080572.indd 1463 10/20/08 2:43:49 PM

decreased from 30% to 2-4% in well-controlled insulin dependent diabetic (IDDM) mothers.[5,6] These perinatal deaths in IDDM pregnancies are caused mainly by congenital malformations (30-40%), prematurity (20-30%), intrauterine and/or intrapartum asphyxia (20-30%), birth trauma and unexplained stillbirth.[5-7] Fetal macrosomia is a term used to describe the abnormal large size of the body of fetus-neonate usually ≥4000 g (8 lb, 13 oz) or ≥4500 g (9 lbs 4 oz) regardless of gestational age.[8,9] Diabetes (pregestational and gestational) and other maternal risk factors that favor the likelihood to develop fetal macrosomia included; obesity, height, multiparity, prolonged gestation, previous infant weighing ≥4000 g, and advanced maternal age.[8] Increasing birth weight ≥4000g is known to increase infants' risks for shoulder dystocia, traumatic injury, and birth asphyxia greater than those of the general obstetric population.[5,8] Furthermore, their mothers are at increased risk of cesarean delivery, postpartum hemorrhage, and genital laceration.[4] The macrosomic fetuses of the diabetic mothers are likely to be at 3-9 times greater risk of perinatal morbidity and mortality, compared with those macrosomic fetuses of nondiabetic mothers.[10] Controversy exists concerning the ideal method of delivery of macrosomic fetuses in reducing adverse outcomes, both in diabetic and nondiabetic pregnancies. Several authors have recommended elective delivery, either by induction of labor or cesarean delivery at an estimated fetal weight ≥4000g before full term.[11-14] While others have shown that cesarean deliveries greatly reduce the likelihood of shoulder dystocia, and therefore avoid brachial plexus injury at the expense of increasing maternal morbidity compared to vaginal delivery. The clinical practice of elective cesarean delivery is both empirical and controversial and has not been supported by randomized controlled trials. This retrospective case-control study was conducted to compare the maternal morbidity, mode of delivery, fetal, and neonatal outcomes of fetal macrosomia in diabetic and nondiabetic women.

Methods. We performed a retrospective chart review for all women who delivered at Riyadh Military Hospital, Riyadh, Kingdom of Saudi Arabia from January 2004 to December 2006. We included all non-hydropic singleton pregnancies who delivered at ≥37 weeks' gestation and weighing ≥4000 g. The study was approved by our Institutional Review Board. We excluded from the study all women with large fetus that had congenital abnormality that caused mechanical problem, breech presentation, major placenta previa (placenta grade 3 or 4) and pelvic deformity. A total of 766 macrosomic newborns met the inclusion criteria. Maternal, fetal, and neonatal outcomes in relation to maternal diabetes were compared between the 2 groups. Group 1 comprised diabetic women (n=207) and group 2 comprised nondiabetic women (n=559). The characteristics of the study groups including age, parity, gestational age, height, pre pregnancy weight, weight gain during pregnancy, type of diabetes, diabetic control during pregnancy, and previous history of lower segment cesarean delivery are shown in **Table 1**. Characteristics of labor, mode of delivery, and length of hospital stay are shown in **Table 2**. Diabetes was categorized into pregestational diabetes mellitus (PGDM) and gestational diabetes mellitus treated with diet alone (GDOD), or with insulin (GDOI). Patients who were known to have PGDM were admitted at 4 weeks gestation for insulin therapy and stabilizing serum glucose levels. Gestational diabetes screening was routinely performed on all pregnant women at 24-28 weeks' gestation using oral glucose tolerance test (OGTT).[15] The department policy for management of women with GDOD is induction of labor when the gestational age is >40 completed weeks. Whereas, women with GDOI or PGDM were induced at 38 completed weeks' gestation. Maternal complications related

Table 1 - Demographic characteristics of the study population (n=766). Group 1 diabetic women (n=207) and group 2 nondiabetic women (n=559).

Maternal characteristics	Group 1 n = 207 (%)	Group 2 n = 559 (%)	*P*-value
Age (years)	33.6±5.8	30.5±6.2	0.001
Parity	4.9±2.8	3.4±2.5	0.001
0	10 (4.8)	52 (9.3)	0.06
1-3	61 (29.5)	262 (46.8)	0.0001
> 4	136 (65.7)	245 (43.9)	0.0001
Gestational age (weeks)	39.7±1.3	40.7±1.2	0.001
Maternal height (cm)	157.9±5.2	158.8±5.3	0.03
Pregestational maternal weight (kg)	82.8±14.2	78.5±14.2	0.001
Maternal weight (kg) at delivery	89.8±14.3	86.2±13.6	0.004
Maternal weight (kg) gain	7.2±4.7	8.0±4.9	0.08
Essential hypertension	13 (6.3)	0	0.0001
Diabetes type			
GDM	178 (86)	0	
PGDM	29 (14)	0	
Diabetes control during pregnancy		0	
Controlled	153 (73.9)	0	
Uncontrolled	54 (26.1)		
Previous delivery of birth weight ≥ 4000 g	70 (33.8)	159 (28.4)	0.18
Previous one LSCS	41 (19.8)	81 (14.5)	0.09

Values are means±SD with (%) in parentheses, GDM - gestational diabetes mellitus, PGDM - pregestational diabetes mellitus, LSCS - lower segment cesarean section

15Fetalmacro20080572.indd 1464 10/20/08 2:43:49 PM

to birth (vaginal or cesarean delivery) were assessed during hospital stay until discharge and at 6 weeks post discharge (**Table 3**). The pediatrician on call assessed the neonatal outcomes immediately after delivery until discharge. Fetal congenital anomalies are shown in **Table 4**. Neonatal outcome; gender, birth weight, one, and 5 minute Apgar scores, neonates needing resuscitation and/or admission to neonatal intensive care unit (NICU), and length of hospital stay is depicted in **Table 5**. Intrapartum, early and late neonatal complications related to the birth and delivery were analyzed along with asphyxia, seizures occurring at less than 24 hours of age and birth trauma (**Tables 5 & 6**). Asphyxia was defined as a neonate with one minute Apgar score <4 who required positive pressure ventilation for up to 3 minutes before sustained spontaneous respiration developed. A post asphyxic convulsion was defined as tonic\clonic convulsions, usually repetitive in the first 3 days of life with no other apparent cause than significant birth asphyxia or severe fetal distress. Erb's and brachial nerve paralysis persisting to the time of discharge were considered a neonatal complication. Certified midwives under the supervision of resident, registrar, senior registrar, and consultant on call conducted most of the deliveries. Progress of labor was monitored regularly, and when necessary labor was augmented with intravenous oxytocin. Continuous fetal heart monitoring by electronic cardiotocogram was used for all patients during labor. A diagnosis of fetal distress was made in the presence of any of the following: prolonged deceleration, bradycardia, decreased variability, or thick meconium. Shoulder dystocia was defined as a failure of delivery of fetal shoulder(s), whether they were anterior, posterior or both, that required a special maneuver for

Table 2 - Characteristics of labor and mode of delivery of the study population (n=766). Group 1 diabetic women (n=207) and Group 2 nondiabetic women (n=559).

Characteristics	Group 1 n = 207 (%)	Group 2 n = 559 (%)	*P*-value
Labor			
spontaneous	136 (65.7)	471 (84.3)	0.0001
induced	71 (34.3)	88 (15.7)	
Analgesia/ anesthesia used			
None	43 (20.8)	121 (21.6)	0.9
Entonox	62 (30.0)	191 (34.2)	0.3
Pethidine	37 (17.9)	111 (19.9)	0.6
Epidural	14 (6.8)	47 (8.4)	0.6
Spinal	2 (1.0)	6 (1.1)	0.9
General anesthesia	49 (23.7)	83 (14.8)	0.006
Women needing oxytocin augmentation	92 (44.4)	182 (32.6)	0.003
First stage of labor (hours)	5.3 ± 2.8	5.2 ± 3.0	0.9
Second stage of labor (minutes)	20.2 ± 25.5	21.8 ± 28.2	0.5
Total blood loss (ml)	277 ± 249	233 ± 180	0.008
Women needing blood transfusion	5 (2.4)	8 (1.4)	0.5
Vaginal delivery			
SVD	139 (67.1)	425 (76.0)	0.02
forceps/vacuum	5 (2.4)	25 (4.5)	0.3
Cesarean delivery			
Elective	28 (13.5)	32 (5.7)	0.0001
Emergency	35 (16.9)	77 (13.8)	0.3
Hospital stay (days)	3.6±2.5	2.8 ± 2.1	0.001

Values are means ± SD with (%) in parentheses.
SVD - spontaneous vaginal delivery

Table 3 - Maternal complications for the study groups. Group 1 diabetic women (n=26) and group 2 nondiabetic women (n=79).

Complications	Group 1 n = 26/207 (12.6%)	Group 2 n = 79/559 (14.1%)	*P*-value
Second degree tear	6 (2.9)	41 (7.3)	0.04
Third degree tear	0	2 (0.35)	0.9
Paraurethral tear	1 (0.5)	4 (0.7)	0.9
Cervical laceration	0	1 (0.2)	0.6
Postpartum hemorrhage	10 (4.8)	16 (2.9)	0.3
Women needing blood transfusion	5 (2.4)	8 (1.4)	0.5
Fever	1 (0.5)	1 (0.2)	0.9
Wound infection	1 (0.5)	2 (0.35)	0.7
UTI	0	1 (0.2)	0.6
URTI	2 (1.0)	1 (0.2)	0.4
Endometritis	0	1 (0.2)	0.6
Hysterectomy	0	1 (0.2)	0.6
Total	**26**	**79**	**0.7**

UTI - urinary tract infection, URTI - upper respiratory tract infection

Table 4 - Fetal congenital anomalies in the study groups. Group 1 diabetic women (n=10) and group 2 nondiabetic women (n=22).

Type of anomaly	Group 1 n = 10/207 (4.8%)	Group 2 n = 22/559 (3.9%)	*P*-value
Congenital heart disease	5 (2.4)	3 (0.5)	0.06
Hydrocephalus	2 (1.0)	1 (0.2)	0.3
Ganglion on the hand	1 (0.5)	0	0.6
Cleft lip	2 (1.0)	0	0.1
Undescended testes	0	4 (0.7)	0.5
Syndactyl	0	1 (0.2)	0.6
Hypospadias	0	4 (0.7)	0.5
Horseshoe kidney	0	1 (0.2)	0.6
Congenital dislocated hip	0	3 (0.5)	0.7
Intracranial cyst	0	1 (0.2)	0.6
Bilateral hydrocele	0	2 (0.35)	0.9
Down syndrome	0	1 (0.2)	0.6
Holoprosencephaly	0	1 (0.2)	0.6
Total	**10**	**22**	**0.7**

15Fetalmacro20080572.indd 1465 10/20/08 2:43:50 PM

the delivery of shoulders other than downward traction of the fetal head. It was graded as mild if it required one maneuver, moderate if it required 2 maneuvers, and severe if it required 3 maneuvers to relieve the dystocia. We used the McRobert's maneuver and suprapubic pressure as the first maneuvers for the management of shoulder dystocia. Mothers and neonates were followed-up until 3 months post partum to determine the occurrence of complications. All neonatal injuries have been confirmed by experienced pediatric orthopedics. Neonates who had birth trauma and congenital anomalies were followed up for at least one year.

Data analysis. Independent Student t test was used to compare the mean differences between groups. Fisher's exact and Chi-square tests were used as appropriate. Two-tailed tests were used, and a $p<0.05$ was considered statistically significant. Univariate and multivariate logistic regression analyses were used to examine the impact of various factors on the shoulder dystocia and other neonatal complications. Forward as well as backward selection of parameters was applied, using $p<0.05$, and $p<0.1$ for entry or deletion.

Result. There was a total of 14600 deliveries during the study period of which 819 neonates (5.6%) had birth weight ≥4000 g. Of the 819 macrosomic neonates, 53 were excluded due to non-vertex presentation (n=20), major placenta previa (n=13), hydropic fetalis (n=5), and preterm delivery (<37 completed weeks) (n=15). A total of 766 macrosomic newborns met the inclusion criteria and were available for analysis. There were significantly more macrosomic newborns in nondiabetic women, 73% versus 27% in diabetic women (OR=7.3, 95% CI: 5.8-9.2, p=0.0001). The diabetic women were sub grouped into PGDM (n=29), GDOI (n=48) and GDOD (n=130). There were significantly on average older age women, more multiparous women ≥4, heavier weights at conception and at delivery and more likely to have chronic hypertension (6.3% versus 0) in the diabetic women group compared to the nondiabetic women group. On average, there was significantly higher gestational age at delivery and taller height in the nondiabetic women group compared to the diabetic women. There were no significant differences between either group in maternal weight gain during pregnancy, history of previous delivery of birth weight ≥4000 g, and previous history of one lower segment cesarean delivery. A total of 122 patients (15.9%) had previous one cesarean delivery in both groups (**Table 1**). In the previous cesarean groups, 62 patients (50.8%) were given trial of labor whereas 60 patients (49.2%) had elective repeat cesarean delivery due to clinically big baby. There were significantly more women who needed labor induction and oxytoxin augmentation,

Table 5 - Neonatal outcomes for the study groups (n = 766). Group 1 diabetic women (n=207) and Group 2 nondiabetic women (n=559).

Neonatal characteristic	Group 1 n = 207 (%)	Group 2 n = 559 (%)	*P*-value
Gender			
Male	123 (59.4)	357 (63.9)	0.3
Female	84 (40.6)	202 (36.1)	
Birth weight (g)	4231±241	4211±207	0.3
Apgar score at 1 minute	8.2±1.3	8.4±1.0	0.02
Apgar score at 5 minute	9.3±0.7	9.4±0.6	0.1
Resuscitation			
No	176 (85)	524 (93.7)	0.0001
Yes	31 (15)	35 (6.3)	0.0001
Admission to NICU			
No	167 (80.7)	509 (91.1)	0.0001
Yes	40 (19.3)	50 (8.9)	0.0001
Shoulder dystocia			
No	196 (94.7)	544 (97.3)	0.1
Mild	3 (1.4)	7 (1.3)	0.9
Moderate	4 (1.9)	7 (1.3)	0.7
Severe	4 (1.9)	1 (0.2)	0.03
Stillbirth	1 (0.2)	3 (1.4)	0.1
Early neonatal death	1 (0.5)	0	0.5
Hospital stay (day)	3±2.5	2.4±2.0	0.001

Values are means±SD with (%) in parentheses.
NICU - neonatal intensive care unit

Table 6 - Neonatal complications for the study groups. Group 1 diabetic women (n=33) and group 2 nondiabetic women (n=30).

Birth related injuries	Group 1 n = 33 / 207 (15.9%)	Group 2 n = 30 / 559 (5.4%)	*P*-value
Erb's palsy	3 (1.4)	3 (0.5)	0.7
Brachial nerve injury	1 (0.5)	1 (0.2)	0.9
Asphyxia	2 (1.0)	2 (0.35)	0.6
Meconium aspiration	3 (1.4)	1 (0.2)	0.1
Humerus fracture	0	1 (0.2)	0. 6
Cephalohematoma	1 (0.5)	1 (0.2)	0.9
Subconjunctival hematoma	1 (0.5)	1 (0.2)	0.9
Hypoglycemia	10 (4.8)	5 (0.9)	0.001
RDS	1 (0.5)	0	0.6
Fever	2 (1.0)	4 (0.7)	0.9
Stridor	1 (0.5)	1 (0.2)	0.9
Jaundice	7 (3.4)	9 (1.6)	0.2
Seizures	1 (0.5)	1 (0.2)	0.9
Total	**33**	**30**	**0.0001**

Values are (%) in parentheses.
RDS - respiratory distress syndrome

15Fetalmacro20080572.indd 1466 10/20/08 2:43:51 PM

cesarean delivery, on average higher total blood loss and length of hospital stay in the diabetic women group. There were significantly more spontaneous vaginal deliveries occurring in nondiabetic women 76% versus 67.1% in diabetic women (OR=1.6, 95% CI: 1.1-2.2, *p*=0.02) . However, there was no significant difference between either group in the operative vaginal delivery (vacuum or forceps) . The total cesarean delivery rate in our study population was 172 of 766 cases (22.5%). It was significantly higher in diabetic women compared to nondiabetic women 30.4% versus 19.5% (OR=1.8, 95% CI: 1.2-2.6, *p*=0.002). This significant difference was seen only in the elective cesarean delivery and disappeared in emergency cesarean delivery (**Table 2**). The indications for the emergency cesarean deliveries were: failure to progress (n=43), fetal distress (n=30), poor maternal effort (n=8), prolonged second stage (n=8), cord prolapse (n=3), failed instrumental delivery (n=9), transverse lie (n=3), failed induction (n=5), and abruptio placenta (n=3). There were no significant differences between either group in the length of first and second stages of labor and women needing blood transfusion (**Table 2**). There was no reported maternal death in our study. There were no significant differences between either group in the total maternal morbidity (12.6% versus 14.1%, *p*=0.7), however, nondiabetic women tended to have significantly more second-degree vaginal tears than diabetic women, (OR=2.7, 95% CI: 1.1-7.1, *p*=0.04) (**Table 3**). A total of 32 newborns (4.2%) had major and minor congenital anomalies. Ten anomalies (4.8%) occurred in newborns of diabetic women and 22 anomalies (3.9%) occurred in newborns of nondiabetic women. There were no significant differences between either group with regards to newborn congenital anomalies (*p* =0.7) (**Table 4**). There were 5 cases (0.7%) of perinatal mortality reported in our study population, 4 had stillbirth, and one had early neonatal death. There were no significant differences between either group in perinatal mortality rates of diabetic women and nondiabetic women (0.97% versus 0.5%, *p*=0.9). There were no significant differences between either group in newborn gender, mean birth weight, and Apgar scores at 5 minutes. There were significant low mean one-minute Apgar scores in newborns of diabetic women compared to newborns of nondiabetic women. There were significantly more neonates needing resuscitation and admission to NICU (OR=2.6, 95% CI: 1.5-4.5, *p*=0.0001 and OR=2.4, 95% CI: 1.5-3.9, *p*=0.0001) in the diabetic group compared to the nondiabetic group (**Table 5**). Shoulder dystocia occurred in 26 cases (3.4%) of the studied population. All cases of shoulder dystocia were encountered during vaginal delivery. There was no significant difference between either group in the total grades of shoulder dystocia (5.3% versus 2.7%, *p*=0.1). However, there were significantly more severe cases of shoulder dystocia occurring in newborns of diabetic women compared to nondiabetic women (OR=11, 95% CI: 1.2-63.7, *p*=0.03) (**Table 5**). A total of 62 newborns (8.1%) had neonatal complications in our studied population. There were significantly higher complications occurring in newborns of diabetic women compared to nondiabetic women (15.9% versus 5.4%, OR=3.3, 95% CI: 1.9-5.8, *p*=0.0001). This was due to more neonatal hypoglycemia occurring in neonates of diabetic women (OR=5.6, 95% CI: 1.7-19.1, *p*=0.001) (**Table 6**).

Discussion. Fetal macrosomia is a common obstetrical condition occurring in 10% of liveborn infants weighing ≥4000 g, and in 1.5% of infants weighing ≥4500 g.[1-5] As birth weight increases, the maternal and the perinatal complications increase. In this retrospective study, our total incidence of fetal macrosomia weighing ≥4000 g was 5.6%, and 0.5% when the birth weight was ≥4500 g, which is less than that previously reported in the literature.[1-5] Maternal and perinatal outcomes of 207 newborns (27%) from diabetic mothers were compared with 559 newborns (73%) from nondiabetic controls of similar birth weight. A total of 172 cesarean deliveries occurred in our studied population, with an overall incidence of 22.5%. Agree with previous reports, we found that the incidence of cesarean delivery was significantly higher in diabetic mothers, 30.4% versus 19.5% in nondiabetic mothers (*p*=0.002).[11-14] In our study, this increased cesarean delivery rate was mainly due to elective procedures rather than labor abnormality. The total maternal complications associated with cesarean deliveries were 20/172 (11.6%) with no significant differences between either group. A total of 594 newborns had vaginal delivery for both groups. More women needed induction at 38 and at 40 completed weeks in the diabetic group, who were controlled with insulin and diet, as per our department policy. The maternal complications associated with vaginal deliveries were encountered in 72 cases (12.1%). We found that there were no significant differences between either group in total maternal morbidity (**Table 3**). Surprisingly, nondiabetic mothers have significantly more second-degree vaginal tears than diabetic women 7.3% versus 2.9 %. This is in fact, due to more nondiabetic women having vaginal deliveries than diabetic women (80.5% versus 69.6%). Infants of diabetic mothers in our study population had significantly higher complication rates compared to infants of nondiabetic mothers (15.9% versus 5.4%). However, this is due to more neonates having hypoglycemia in diabetic mothers.[10] This neonatal hypoglycemia was discovered within one to 24

15Fetalmacro20080572.indd 1467 10/20/08 2:43:51 PM

hours post delivery in asymptomatic neonates, of which the majority required early administration of milk without sequelae. Shoulder dystocia in our study was encountered in 26 cases during vaginal deliveries. The incidence of shoulder dystocia in our study was 3.4%, which is consistent with that reported in the literature of 0.2-4.9%.[16-18] All cases of moderate and severe shoulder dystocia had nerve injuries, bone fracture, and birth asphyxia requiring resuscitation, intubation, and admission to NICU. One neonatal death was reported in our study due to hypoxic ischemic encephalopathy related to intractable shoulder dystocia in the diabetic mother group. The 2 infants with brachial plexus injury reported in our studied population recovered without sequelae within 2 weeks to 3 months. Agree with the recently published review by Gherman et al,[19] we found that pre pregnancy, and antepartum risk factors (maternal age, parity, pre pregnancy weight, and total weight gain, postdate, maternal diabetes, diabetic control) were poor predictions of shoulder dystocia. In our study, multivariable logistic regression analyses were used to control for confounding factors. Results yielded that only increasing birth weights significantly increased the risk of shoulder dystocia. There is no consensus on what weight an infant is considered to be macrosomia.[18,20] To define the weight threshold for shoulder dystocia, in our study the birth weight was divided into 3 sub groups; 4000-4249 g, 4250-4499 g, and ≥4500 g. We found that the odds ratio (OR) of shoulder dystocia was increased to 3.6 and 6.5 when birth weights were ≥4500 g for nondiabetic and ≥4250 g for diabetic women. Our incidence of shoulder dystocia with infant birth weight ≥4500 g was 2.9%. It was lower than that previously reported 10-16% due to our strict definition of shoulder dystocia.[13,19,21] It seems reasonable to intervene either with labor induction or prophylactic cesarean delivery when macrosomia is suspected. However, systematic reviews comparing expectant management versus labor induction, have not shown to reduce the risk of cesarean section (relative risk [RR]=0.96), instrumental deliveries (RR=1.02), maternal morbidity or perinatal morbidity (RR=1.06).[22,23] These review trials involved 372 women, none of which were diabetic, and were too small to be sure of the outcomes. Langer et al[13] showed that 76% of shoulder dystocia cases occurring in diabetic women would be prevented with an increased overall cesarean delivery rate of 0.26% by using a threshold of 4250 g.[13] Gonen et al[14] reviewed the policy that recommended cesarean delivery for estimated fetal weight ≥4500 g, they found an insignificant effect on the incidence of brachial plexus palsy. This is due to the fact that 84% of their patients did not have the macrosomia diagnosed before birth. The estimation of the baby's weight in utero is difficult and not accurate. Clinical estimation based on feeling the uterus, measuring fundal height and/or ultrasound weight estimation when birth weight ≥4000 g, is limited by substantial false-positive and false-negative rates.[24] It is well known that the occurrence of poor neonatal outcome increases markedly when the birth weight ≥4500 g.[20] Consequentially, the knowledge that the fetal weight is excessive would be of value in avoiding overzealous attempts at vaginal delivery.

There are a few inherited weaknesses in this study: the retrospective nature of the study, no control group consisting of fetal weight <4000 g and insufficient long-term follow up of maternal and children's complications following vaginal delivery of macrosomic infants.

In conclusion, we believe that shoulder dystocia and birth trauma are unpredictable through clinical indicators, but macrosomia is a major risk factor. Therefore, the definition of fetal macrosomia as ≥4000 g may be more relevant than that of ≥4500 g in modern obstetrics. Elective cesarean delivery with birth weights of ≥4500 g for nondiabetic, and ≥4250 g for diabetic mothers may reduce neonatal complications and avoid moderate and severe shoulder dystocia without increasing maternal morbidity rates. This practice, in conjunction with intensified management of diabetes improves the outcomes for infants of diabetic mothers.

References

1. Lethbridge-Çejku M, Schiller JS, Bernadel L. Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2002. National Center for Health Statistics. ***Vital Health Stat*** 2004; 10: 1-160.
2. Ehrenberg HM, Mercer BM, Catalano PM. The influence of obesity and diabetes on the prevalence of macrosomia. ***Am J Obstet Gynecol*** 2004; 191: 964-968.
3. Kitzmiller JL, Buchanan TA, Kjos S, Combs CA, Ratner RE. Pre-conception care of diabetes, congenital malformations, and spontaneous abortions. Diabetes Care 1996; 19: 514-541.
4. Lipscomb KR, Gregory K, Shaw K. The outcome of macrosomic infants weighing at least 4500g: Los Angeles County + University of Southern California experience. ***Obstet Gynecol*** 1995; 85: 558-564.
5. Yang J, Cummings EA, O'Connell C, Jangaard K. Fetal and neonatal outcomes of diabetic pregnancies. ***Obstet Gynecol*** 2006; 108: 644-650.
6. Jensen DM, Damm P, Moelsted-Pedersen L, Ovesen P, Westergaard JG, Moeller M, et al. Outcomes in type 1 diabetic pregnancies: a nationwide, population-based study. ***Diabetes Care*** 2004; 27: 2819-2823.
7. Stotland NE, Caughey AB, Breed EM, Escobar GJ. Risk factors and obstetric complications associated with macrosomia. ***Int J Gynaecol Obstet*** 2004; 87: 220-226.
8. Chauhan SP, Grobman WA, Gherman RA, Chauhan VB, Chang G, Magann EF, et al. Suspicion and treatment of the macrosomic fetus: a review. ***Am J Obstet Gynecol*** 2005; 193: 332-346.
9. American College of Obstetricians and Gynecologist. Fetal macrosomia. The College. Washington (DC); ACOG: 2000. Practice Bulletin No. 22.

15Fetalmacro20080572.indd 1468 10/20/08 2:43:52 PM

10. Schwartz R, Teramo KA. Effects of diabetic pregnancy on the fetus and newborn. ***Semin Perinatol*** 2000; 24: 120-135.
11. Conway DL, Langer O. Elective delivery of infants with macrosomia in diabetic women: reduced shoulder dystocia versus increased cesarean deliveries. ***Am J Obstet Gynecol*** 1998; 178: 922-925.
12. Menticogluo SM, Manning FA, Morrison I, Harman CR. Must macrosomic fetuses be delivered by a cesarean section ? A review of outcome for 786 babies greater than or equal to 4500 g. ***Aust N Z J Obstet Gynaecol*** 1992; 32: 100-103.
13. Langer O, Berkus MD, Huff RW, Samueloff A. Shoulder dystocia: should the fetus weighing greater than or equal to 4000 g be delivered by cesarean section? ***Am J Obstet Gynecol*** 1991; 165: 831-837.
14. Gonen R, Bader D, Ajami M. Effects of a policy of elective cesarean delivery in cases of suspected fetal macrosomia on the incidence of brachial plexus injury and the rate of cesarean delivery. ***Am J Obstet Gynecol*** 2000; 183: 1296-1300.
15. Carpenter M, Coustan DR. Criteria for screening tests for gestational diabetes. ***Am J Obstet Gynecol*** 1982; 144: 768-773.
16. Benito CW, Thayer CF, Lake MF, Knuppel RA, Vintzileos AM. Predictors of fetal macrosomia. ***Am J Obstet Gynecol*** 1996; 174: 349.
17. O'Leary JA, Leonetti HB. Shoulder dystocia: prevention and treatment. ***Am J Obstet Gynecol*** 1990; 162: 5-9.
18. Grassi AE, Giuliano MA. The neonate with macrosomia. ***Clin Obstet Gynecol*** 2000; 43: 340-348.
19. Gherman RB, Chauhan S, Ouzounian JG, Lerner H, Gonik B,. Goodwin TM. Shoulder dystocia: the unpreventable obstetric emergency with empiric management guidelines. ***Am J Obstet Gynecol*** 2006; 195: 657-672.
20. Gregory KD, Henry OA, Ramicone E, Chan LS, Platt LD. Maternal and infant complications in high and normal weight infants by method of delivery. ***Obstet Gynecol*** 1998; 92: 507-513.
21. Blickstein I, Ben-Arie A, Hagar ZJ. Antepartum risks of shoulder dystocia and brachial plexus injury for infants weighing 4,250 g or more. ***Gynecol Obstet Invest*** 1998; 45: 77-80.
22. Sanchez-Ramos L, Bernstein S, Kaunitz AM. Expectant management versus labor induction for suspected fetal macrosomia: A systematic review. ***Obstet Gynecol*** 2002; 100: 997-1002.
23. Iron O, Bolivian M. Induction of labour for suspected fetal macrosomia. Cochrane Database of Systematic Reviews 1998, Issue 2. Art. No.: CD000938. DOI: 10.1002/14651858. CD000938.
24. O'Reilly-Green C, Divon M. Sonographic and clinical methods in the diagnosis of macrosomia. ***Clin Obstet Gynecol*** 2000; 43: 309-320.

Authorship Entitlement

Excerpts from the Uniform Requirements for
Manuscripts Submitted to Biomedical Journals
updated November 2003.
Available from www.icmje.org

The international Committee of Medical Journal Editors has recommended the following criteria for authorship; these criteria are still appropriate for those journals that distinguish authors from other contributors.

Authorship credit should be based on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) intellectual content; and 3) final approval of the version to be published. Authors should meet conditions 1, 2, and 3.

Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

Author should be prepared to explain the order in which authors are listed.

15Fetalmacro20080572.indd 1469 10/20/08 2:43:52 PM