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Maternal and neonatal outcomes of macrosomic pregnancies

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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Summary

Background: To compare maternal and neonatal outcomes of term macrosomic and adequate for gestational age (AGA) pregnancies.

Material/Methods: A retrospective analysis was performed on all term singleton macrosomic (birth weight ⩾4000 g) and AGA (birth weight >10th percentile and <4000 g) pregnancies delivered at our hospital between 2004 and 2008. Data collected included maternal age, gestational age at delivery, mode of delivery, birth weight, fetal gender, maternal and neonatal complications. Comparisons were made between macrosomic and AGA pregnancies and between different severities of macrosomia (4000–4250 g, 4250–4500 g and ⩾4500 g).

Results: The study population comprised of 34,685 pregnancies. 2077 neonates had birth weight ⩾4000 g. Maternal age and gestational age at delivery were significantly higher for macrosomic neonates. Significantly more macrosomic neonates were born by cesarean section, and were complicated with shoulder dystocia, neonatal hypoglycemia, and had longer hospitalization period (both in vaginal and cesarean deliveries). Specifically, the odds ratio (OR) relative to AGA pregnancies for each macrosomic category (4000–4250 g, 4250–4500 g and ⩾4500 g) of shoulder dystocia was 2.37, 2.24, 7.61, respectively, and for neonatal hypoglycemia 4.24, 4.41, 4.15, respectively. The risk of post partum hemorrhage was statistically increased when birth weight was >4500 g (OR=5.23) but not for birth weight between 4000–4500 g. No differences were found in the rates of extensive perineal lacerations between AGA and the different macrosomic groups.

Conclusions: Macrosomia is associated with increased rate of cesarean section, shoulder dystocia, neonatal hypoglycemia, and longer hospitalization, but not associated with excessive perineal tears. Increased risk of PPH was found in the >4500g group.

key words: **macrosomia • post partum hemorrhage • cesarean section • perineal tear • shoulder dystocia • neonatal hypoglycemia**

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Background

The management of macrosomic pregnancies, defined as birth weight ≥4000 g, has become a common dilemma in daily obstetric practice due to the increasing incidence of macrosomic deliveries [1].

Labor and delivery of macrosomic pregnancies pose potential risks for both mothers and neonates. Maternal complications include an increased rate of cesarean sections, extensive perineal lacerations and severe hemorrhage. Neonatal complications consist of shoulder dystocia, hypoglycemia, respiratory distress and death [1–3]. These adverse outcomes were reported in both diabetic and non diabetic pregnancies [4,5]. While there is already an increased risk of morbidity in infants weighing 4,000–4,500 g, the risk of an adverse fetal and maternal outcome increases sharply when the expected birth weight is greater than 4,500 g [4,6,7].

Most of the recent studies on macrosomic pregnancies included hundreds or few thousands pregnancies [1–8]. Our objective was to describe our experience in a larger population in a tertiary center in Israel. All pregnancies were well-dated (with first trimester ultrasound) term macrosomic deliveries. Modern, up-to date obstetrical management protocols were used [8]. Our goal was to analyze the outcomes of macrosomic pregnancies in comparison with adequate for gestational age (AGA) neonates and within the different severities of macrosomia.

Material and Methods

The study population included all consecutive singleton term appropriate-for gestational age (AGA) and macrosomic pregnancies delivered at term between July 1st 2004 and September 30th 2008 at Sheba Medical Center, a large tertiary referral center at the center of Israel with over 10,000 deliveries per annum.

Approval for the study was granted by the Institutional Review Board of the Chaim Sheba Medical Center (number 5407/2008 was obtained on 12/08/08).

Gestational age was determined by first trimester ultrasound measurements in most cases. Second trimester ultrasound before 20 weeks' gestation was performed in patients in whom 1st trimester sonography was not done.

Term was defined as gestational age ≥37 weeks.

Macrosomia was defined as birth weight ≥4000 g. AGA was defined as birth weight >10th percentile according to gender-specific Israeli curves [9] and <4000 g.

The department's patient admission database was screened for the period July 1st 2004 to September 30th 2008. Antenatal follow-up test results along with pregnancy outcomes were routinely entered into the database at admission to delivery and following delivery.

The variables assessed in the study were: maternal age, birth weight, gender, gestational age at delivery, mode of delivery, Apgar scores, number of days of hospitalization, and maternal complications, including diabetes, post partum hemorrhage, extensive perineal tears, and neonatal complications including shoulder dystocia, hypoglycemia, and respiratory complications.

Comparisons were made between AGA and macrosomic maternal-neonatal pairs with birth weights of 4000–4250 g, 4251–4500 g and >4500 g.

Statistical analysis

Statistical analysis was performed using Chi-square test for categorical variables and t-test for continuous parameters. One-way analysis of variance (ANOVA) was applied for comparison of continuous variables between the three categories of macrosomic neonates (4000–4250 g, 4251–4500 g and >4500 g). Logistic regression models were used to assess the effect of macrosomic deliveries and birth weight categories on maternal and neonatal complications, controlling for maternal age, gestational age at delivery, neonatal gender and presence of diabetes. Odds ratios and corresponding 95% confidence interval were derived. A p-value of 0.05 or less was considered statistically significant.

Results

During the study period 37341 singleton neonates were delivered at term at the Chaim Sheba Medical Center. 34,685 neonates were amenable for analysis after exclusion of 2656 neonates whose weight was smaller than the 10th percentile adjusted for the gestational age at delivery according to gender-specific Israeli curves [9].

Comparisons between AGA neonates and the different severities of macrosomic neonates are described in Table 1.

Maternal age and gestational age at delivery were significantly higher in macrosomic neonates. Significantly more macrosomic neonates delivered post-term (41 wks and later). The ratio between boys and girls significantly increases with the birth weight, being 1.004 for AGA neonates, 1.94 for birth weight 4000–4250 g, 2.16 for birth weight 4251–4500 g and 3.1 for birth weight >4500 g.

Significantly more AGA neonates were born vaginally, while more than half of the neonates whose birth weight was >4500 g were delivered by cesarean section.

Not unexpectedly, significantly more macrosomic pregnancies were associated with diabetes and complicated with post partum hemorrhage (PPH), shoulder dystocia, and neonatal hypoglycemia. No differences were found in the frequency of extensive perineal lacerations between AGA and macrosomic pregnancies both in the entire study population and after exclusion of cesarean section.

There was a tendency for lower Apgar scores at 5 minutes for the macrosomic neonates, with more macrosomic neonates having scores less than 5 and less than 7.

The duration of maternal hospitalization was significantly higher in the macrosomic deliveries, with longer mean hospital stays with larger neonates. The number of patients in whom the birth weight was >4500 g hospitalized more than 4 days was 2.7-times higher than in the AGA group. This

Table 1. Distribution of the study population by selected characteristics and birth weight categories (birth week ≥37).

	Birth weight categories (grams)				p
	<4000	4000–4250	4251–4500	>4500	
N	32,608	1,433	472	172	
Maternal age (years)					
Mean ±SD	30.9±4.9	31.4±4.8	31.7±4.9	31.4±5.3	<0.001
Range	16–	59	17–49	19–45	18–42
GA at delivery					
Mean ±SD	39.2±1.2	40±1.1	40.1±1.1	39.8±1.1	<0.001
Range	37–43	37–43	37–42	37–42	
41–43 wks (%)	14.7	32.9	38.8	27.9	<0.001
Gender (%)					
Male	50.1	66.0	68.4	75.6	<0.001
Female	49.9	34	31.6	24.4	
APGAR 5					
<7 (%)	1.6	1.8	2.1	3.5	0.15
7–10 (%)	98.4	98.2	97.9	96.5	
Duration of hospitalization (days)					
Mean ±SD	2.70±2.16	3.04±3.02	3.12±1.60	3.41±1.69	<0.001
Range	1–66	1–92	1–15	1–10	
>4 (%)	6.0	8.4	9.3	16.2	<0.001
Mode of delivery (%)					
NVD	72.7	64.6	59.2	45.9	<0.0001
Operative vaginal delivery	6.5	5.2	2.7	2.9	
LSCS	20.8	30.2	38.1	51.2	
Complications (%)					
Maternal					
Diabetes (n=1525)	4.3	5.7	7.8	11.6	<0.001
Extensive perineal tear (n=128)	0.36	0.49	0.20	0.58	0.7
PPH (n=124)	0.34	0.42	0.61	1.74	0.05
Neonatal					
Shoulder dystocia (n=279)	0.71	1.91	1.84	5.81	<0.001
Hypoglycemia (n=650)	1.61	5.79	6.35	6.98	<0.001
Respiratory problems (n=502)	1.45	1.13	1.84	2.33	0.5

GA – gestational age; NVD – normal vaginal delivery; LSCS – low segment cesarean section; PPH – post partum hemorrhage.

difference remained statistically significant when analysis was made controlling for mode of delivery.

A multivariate analysis of the effect of macrosomic deliveries on maternal and neonatal complications adjusted for maternal age, gestational age at delivery, neonatal gender and presence of diabetes compared with AGA pregnancies is presented in Table 2. The risks of shoulder dystocia and neonatal hypoglycemia increased significantly as the birth weight increased, while the risk of PPH was significantly increased only with birth weight over >4500 g. Extensive maternal perineal tears were not increased with increasing birth weight, both in the entire study population and after exclusion of cesarean sections.

Discussion

Several questions confront both the pregnant woman and her obstetrician prior to delivery of a suspected macrosomic fetus, and the need arises for tailoring the optimal management for each specific patient.

Table 2. Effect of birth weight on maternal and neonatal complications. Multivariate logistic regression analyses

		Birth weight categories									
		<4000 g	4000–4250 g			4251–4500 g			>4500 g		
		OR*	OR*	95% CI	p	OR*	95% CI	p	OR*	95% CI	p
Maternal complications	Perineal tears*	1.0	1.28	0.59–2.77	0.5	0.53	0.07–3.79	0.5	1.52	0.21–11.02	0.7
	PPH**	1.0	1.03	0.42–2.55	0.9	1.78	0.56–5.69	0.3	5.23	1.63–16.80	0.006
Neonatal complications	Shoulder dystocia	1.0	2.37	1.57–3.58	<0.001	2.24	1.14–4.42	0.02	7.61	3.94–14.73	<0.001
	Hypoglycemia	1.0	4.24	3.30–5.44	<0.001	4.41	2.99–6.50	<0.001	4.15	2.25–7.68	<0.001
	Respiratory*** problems	1.0	0.95	0.57–1.58	0.8	1.57	0.80–3.07	0.2	1.80	0.66–4.90	0.3

Adjusted for maternal age, gestational age at delivery, neonatal gender and maternal diabetes status: * perineal tears – 3rd or 4th degree tears only; ** PPH – post partum hemorrhage; *** respiratory complications of the neonates comprised of transient tachypnea of the newborn, aspiration including meconium aspiration, respiratory distress syndrome, asphyxia, and need for oxygenation or intubation.

Our study demonstrated that in a large obstetrical population with well-dated term singleton pregnancies, as birth weight increased the risk of cesarean delivery, PPH, shoulder dystocia and neonatal hypoglycemia increased.

The incidence of neonatal macrosomia in our study was 6% similar to the reported 5–8% in different study populations, and the incidence of infants weighing over 4,500 g was 0.5%, a little less than the reported 1.0–1.5% in other studies [1,2,10]. This may be attributed to the different study populations.

Maternal age was significantly higher in the macrosomic pregnancies as reported before [10–12].

Previous studies demonstrated that women carrying male fetuses are at increased risk of macrosomia [7,11]. Similarly, the ratio between boys and girls in our study significantly increased with the birth weight, with nearly 3-times more male neonates over 4500 g than females.

One of the advantages in our study population was the well-dated pregnancies. We demonstrated that as the pregnancy progresses the h weight increased, with significantly more macrosomic neonates delivered over 41 weeks' gestation, especially in the 4251–4500 g weight group. Similarly, Ju et al. demonstrated that macrosomia was 4-times more likely in gestations over 40 weeks [7].

The mode of delivery significantly shifts with increasing macrosomia, with significantly more cesarean sections in the macrosomic pregnancies. These rates increased as the birth weight increased, with less than half of neonates with birth weight over >4500 g being delivered vaginally. Similarly, Siggelkow et al. and Lim et al, in their studies on birth weight >4000 g, and Berard et al. in their study on >4500 g showed an overall rate of cesarean section of 27.4%. 43.9% and 36%, respectively [10,13,14]. Nevertheless, Raio et al. and Navti et al. presented smaller rates of overall cesarean section of 16.7% and 22.3%, respectively in the >4500 g group [15,16]. According to some of these authors more elective cesarean sections are performed in nulliparous women when macrosomia is suspected [13], and in others the reason for most cesarean sections was protracted labor [10,16]. These differences may be attributed to the management strategies of every hospital. Furthermore, a recent study by Melamed et al. demonstrated that the sonographic estimation of fetal macrosomia increased the rate of cesarean section regardless of actual birth weight [17]. Smilarly, Bailey et al. reported that among birth weight >4500 g, higher rates of elective cesarean sections were performed when macrosomia was suspected, but women in whom macrosomia was not suspected had higher rates of vaginal deliveries without any increase in neonatal morbidity [18].

The incidence of diabetic pregnancies (both gestational and pre-gestational) was 4.4% in our study population, similar to previous studies [19]. Significantly more macrosomic pregnancies were complicated with diabetes. As the birth weight increased the association with diabetes was stronger.

As reported before, the risk of developing both maternal and neonatal complication such as PPH, shoulder dystocia and neonatal hypoglycemia increased as the birth weight increased. Interestingly, no differences were found in the frequency of extensive perineal lacerations including 3rd and 4th degree laceration between AGA and macrosomic pregnancies both in the entire study population and after exclusion of cesarean sections. Similarly, Siggelkow et al. observed lack of association between perineal trauma and birth weight in macrosomic pregnancies [10]. Contrary to that, other previous studies did find higher rates of maternal lacerations in macrosomic deliveries [13–15].

The increased risk of PPH following macrosomic deliveries found in our study is well known and has been reported previously [13]. A multivariate analysis performed in our study demonstrated that the risk of PPH was significantly increased only with birth weight over >4500 g.

The risk of shoulder dystocia increased as gestational age at delivery increased and in diabetic pregnancies. Similarly, previous studies demonstrated higher rates of shoulder dystocia among birth weight >4000 g [13] that increased

significantly 3–4 times when the birth weight was >4500 g [6,7,14,16,19,20]. Our study demonstrated that the odds ratio for shoulder dystocia was similar in the 4000–4250 g group and the 4250–4500 g pregnancies (was 2.3 times higher compared to AGA pregnancies). The odds ratio for shoulder dystocia increased significantly to 7.6 times higher in the group with birth weight >4500 g compared to the AGA pregnancies.

The odds ratio for neonatal hypoglycemia also increased in our study with increasing birth weight, and in diabetic pregnancies. Similarly, Esakoff et al. reported high incidence of neonatal hypoglycemia in macrosomic neonates both in diabetic and non-diabetic pregnancies [5]. Kraiem et al. reported an increased risk of neonatal hypoglycemia from 2% in the 4000–4500 g group to 18% in the >4500 g group [21]. Akin et al. reported also a 2-fold increased rate of neonatal hypoglycemia in macrosomic pregnancies [11].

The duration of maternal hospitalization increased significantly as the birth weight increased, with 3-times more mothers whose birth weight >4500 g being hospitalized over 4 days. This was not associated with the increased rate of cesarean section, and may be attributed to the increased rate of maternal and neonatal complications. Similarly, Ju et al. found that macrosomia >4500 g associated with 2-times higher risk of maternal hospitalization of more than 3 days [7].

We acknowledge several limitations of our study, mainly the retrospective nature of the analysis. However, the fact that clinical findings were entered prospectively into the database by the obstetric team, as well as large body of evidence available for analysis both increase the reliability of findings. We did not analyze the association of the patients' body mass index and weight gain during pregnancy to fetal macrosomia and pregnancy outcomes, as our goal was to examine the outcomes and not the causes of macrosomic pregnancies.

Conclusions

In conclusion, our study tried to update our knowledge on macrosomic pregnancies. We found that the rates of cesarean deliveries, shoulder dystocia, neonatal hypoglycemia, and longer hospitalization increased as the birth weight increased in all birth weight categories >4000 g, but the risk of PPH significantly increased only in the >4500 g pregnancies. No increase was found in extensive perineal lacerations. Knowledge of these possible maternal and neonatal outcomes may optimize our recommendations to women suspected to carry macrosomic neonate.

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Conflict of interest statement

There are no conflicts of interest for the authors regarding this manuscript.

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