Fetal macrosomia – an obstetrician's nightmare?

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Abstract

OBJECTIVES: Fetal macrosomia is defined as a fetus that is of large size for gestational age, i.e. equal to or greater than the 90th percentile of weight. There is some evidence of increased perinatal mortality and morbidity rates in cases of macrosomia.

DESIGN: This is a retrospective study of patients with term pregnancy. We analyzed the deliveries of 508 infants born with birth weight ≥ 4 200 grams and considered them as a study group. The deliveries of newborns with birth weight less than 4 000 g constituted the control group (330 cases). Maternal and neonatal medical records were retrospectively reviewed for clinical data.

Setting: The study was conducted in Second Department of Obstetrics and Gynecology Warsaw Medical University from January 2004 to December 2007.

RESULTS: Maternal age, parity, BMI and pregnancy weight gain were positively related to fetal macrosomia. Prolonged first stage of labor, cesarean section rate and increased blood loss were observed more frequent in macrososmia. There were no differences between both groups according to Apgar score and neonatal birth trauma. Macrosomia was observed more frequent in male fetuses. Our data showed that careful qualification to way of delivery let us achieve the same good outcome in macrosomia.

CONCLUSIONS: Older obese multiparas are at increased risk of having macrosomic baby. The increased incidence of cesarean section in these women is due to cephalo-pelvic disproportion or obstructed labor. Macrosomia is more often in male fetuses.

Abbreviations:

AC	- abdominal circumference
AFI	- amniotic fluid index
BPD	- biparietal diameter
BMI	- body mass index
cc	- cesarean section
DM	- diabetes mellitus
EFW	- expected fetal weight
FL	- femoral length
GDM G1	- gestational diabetes grade 1
GDM G2	- gestational diabetes grade 2
HC	- head circumference
IVH	- intraventricular hemorrhage
PGDM	- pregestational diabetes mellitus
PIH	- pregnancy induced hypertension
PPH	- prepregnancy hypertension
PROM	- premature rupture of membranes

ORIGINAL ARTICLE

INTRODUCTION

No general consensus exists on the definition of fetal macrosomia. Authors have variably defined it as birth weight greater than 4 000, greater than 4 500 or greater than 5 000 grams, regardless of gestational age, or as large for gestational age. Fetal macrosomia is then defined as a fetus that is of large size for gestational age, i.e. equal to or greater than the 90th percentile of weight (Bręborowicz 2010; Stotland *et al.* 2004). According to ACOG the term macrosomia refers to a fetus, which is beyond 4500 grams (Zhang *et al.* 2008). There is some evidence of increased perinatal mortality and morbidity rates in cases of macrosomia. A number of problems during delivery, such as prolonged duration of delivery, shoulder dystocia, an increased risk of cesarean section, and postpartum hemorrhage have been widely reported. High birth weight or fetal obesity is associated with increased risk of birth trauma during vaginal delivery, specifically including clavicle or humerus fractures and brachial plexus injury (Sanchez-Ramos 2002; Stotland *et al.* 2004). Newborn infants with weight greater than or equal to 4 500 grams are at increased risk for neonatal morbidity, which include assisted ventilation and meconium aspiration. Genetic variance, excessive growth secondary to overweight mothers, excessive maternal weight gain during pregnancy, and gestational or pregestational diabetes mellitus are possible reasons for large for gestational age fetuses (Herbst 2005; Steer 2004).

Tab. 1. Newborn measurements.

Newborn measurements	Control group Mean ± SD [min–max] or n(%)	Study group Mean ± SD [min–max] or n(%)
Birth weight (g)	3 268±162 [2020–3720]	4 392±183 [4200–5270]
Birth length (cm)	53.9±2.4 [47–61]	58.3±2.3 [53–64]
Head circumference (cm)	33.7±14.0 [30–38]	35.8±1.4 [31–40]
Abdominal circumference (cm)	31.3±1.8 [27–37]	34.9±1.5 [31–40]
Shoulder width (cm)	11.9±1.2 [9–15]	13.3±1.1 [11–16]
Chest circumference (cm)	32.7±1.5 [26–38]	36.1±1.3 [33–41]
Ponderal index	21.0±2.4 [14.8–34.0]	22.2±2.2 [16.5–30.4]
Percentile of weight:		
<5	9 (2.7%)	0
5–9	7 (2.2%)	0
10–24	49 (14.8%)	0
25–49	130 (39.4%)	0
50–74	116 (35.2%)	0
75–89	19 (5.6%)	23 (4.5%)
90–95	0	93 (18.3%)
>95	0	392 (77.1%)

MATERIALS AND METHODS

This is a retrospective study of patients with term pregnancy who delivered in the Second Department of Obstetrics and Gynecology Warsaw Medical University from January 2004 to December 2007. We analyzed the deliveries of 508 infants born with birth weight ≥4 200 grams and considered them as a study group. The deliveries of newborns with birth weight less than 4 000 g constituted the control group (330 cases). We restricted the study to women with singleton pregnancy who delivered alive baby at 37 completed gestational weeks or later. Maternal and neonatal medical records were retrospectively reviewed for clinical data. The mean newborn weight in control and study group was 3 268±162 and 4 392±183 grams respectively. The other newborn measurements are showed in Table 1. The highest birth weight was 5 270 g. Maternal measures included demographic and anthropometric information, previous reproductive history, complications during pregnancy, mean duration of first and second stage of labor, delivery route and maternal morbidity (namely postpartum hemorrhage, cesarean section, wound infection and perineal tears). Neonatal outcome measures consisted of Apgar score (at 1st and 5th min), fetal trauma and other neonatal complications.

Statistics

Statistical analysis was performed by using Chi square test, comparison of means, multifactor analysis of variance were used as appropriate to evaluate differences between continuous variables between groups. p-value <0.05 was accepted as indicating statistical significance.

RESULTS

There was no difference between both groups according to marital status and place of residence. Elementary education was less frequent in the study group. There was no difference in numbers of antenatal visits whereas the patients in the control group started their first visit earlier than in the study group (Table 2). We noted that mothers from the study group were older and taller than from the control group (Table 3). Body weight, BMI, weight gain during pregnancy, abdominal circumference and fundal height were statistically different between the groups (Table 3). Multiparous patients were found more often in the study group. There was no difference in history of abortion, prior preterm delivery and previous cesarean section (Table 4). Data of current pregnancy did not show significant difference between the two groups. The exceptions were found in a few conditions like intrahepatic gestational cholestasis, thyroid disease and threatened abortion which were

Tab. 2. Socioeconomic status and antenatal control.

Socioeconomic status and antenatal control	Control group Mean ± SD [min–max] or n(%)	Study group Mean ± SD [min–max] or n(%)	*p*-value
Marital status:			
singular	38 (11.5%)	53 (10.4%)	
married	283 (85.8%)	448 (88.2%)	ns
divorced	7 (2.1%)	6 (1.2%)	
widow	2 (0.6%)	1 (0.2%)	
Education:			
elementary	38 (11.7%)	28 (5.5%)	0.0008
medium	86 (26.4%)	183 (36.1%)	
high	202 (64.7%)	296 (58.4%)	
Residence place:			
city	182 (55.2%)	282 (55.5%)	ns
rural	148 (44.8%)	226 (44.5%)	
Number of antenatal visits:			
up to 4 times	13 (4.2%)	18 (3.6%)	ns
5-8	102 (32.7%)	193 (39%)	
9-12	176 (56.4%)	257 (52%)	
>12	21 (6.7%)	27 (5.5%)	
Booking time (week)	10.1±3.4 [4-32]	11.1±1.5 [6-33]	0.007

Tab. 3. General data.

Maternal characteristics	Control group N=330 Mean ± SD [min–max] or n(%)	Study group N=508 Mean ± SD [min–max] or n(%)	*p*-value
Age (years)	29.6±4.6 [14–43]	30.3±4.6 [17–46]	0.033
Weight (kg)	59.9±10.8 [40–120]	66±12.6 [45–130]	0.00001
Height (cm)	165.2±5.5 152–164	168.3±5.3 156–183	0.00004
BMI (kg/m^2)	21.8±3.7 15.2–44.6	23.4±4.2 16.7–44.6	0.00001
Pregnancy weight gain (kg)	14.0±5.0 [1–30]	17.2±6.1 [0–37]	0.00001
Abdominal circumference (cm)	100.5±7.9 [81–133]	107.6±7.9 [93–138]	0.0001
Fundal height (cm)	35.6±4.6 [28–43]	38.9±4.4 [29–51]	0.0001

Tab. 4. Obstetric history.

Obstetric history	Control group N=330 Mean ± SD [min–max] or n(%)	Study group N=508 Mean ± SD [min–max] or n(%)	*p*-value
Number of pregnancies:			
1	155 (47.0%)	180 (35.4%)	0.02
2	111 (33.6%)	188 (37.0%)	
3	40 (12.1%)	87 (17.1%)	
>3	24 (7.3%)	53 (10.4%)	
Number of mature deliveries:			
1	193 (58.5%)	243 (47.8)	0.017
2	114 (34.5%)	195 (38.3%)	
3	18 (5.5%)	53 (10.4%)	
>3	5 (1.5%)	17 (3.3%)	
History of abortion:			
1	255 (77.3%)	358 (70.5%)	
2	57 (17.2%)	130 (25.5%)	ns
3	17 (5.2%)	15 (3%)	
4	1 (0.3%)	5 (1%)	
Prior preterm delivery:			
0	325 (98.5%)	492 (96.9%)	ns
1	5 (1.5%)	16 (3.1%)	
Previous cesarean section	21 (6.3%)	24 (4.7%)	ns

more frequent in the control group. In addition those patients more often suffered from signs and symptoms of threatened preterm delivery managed with tocolysis, pessary and steroids (Table 5). The mean gestational age at delivery was older in the study group than in the control group (39.6±1.2 versus 38.9±1.2). There was no difference in labor induction. Normal vaginal deliveries were recorded more often in the control group whereas cesarean section was twice more often in study group, both in elective and cesarean section in labor. Emergency cesarean section was performed significantly more often in the control group. The most frequent indications for cesarean section in the study group were cephalo-pelvic disproportion, prolonged first and second stage of labor. First stage of labor in patients who delivered vaginally was significantly longer in the study group but there was no difference in the duration of other stages of labor in both groups. The premature rupture of membranes was observed more frequent in patients with fetal macrosomia but there was no significant difference in interval from PROM to delivery. Meconium stained amniotic fluid was detected more frequent in study group comparing to the control group. The mean blood loss during labor was 415.0±183.0 and 361.5±84.1 milliliters (p=0.0001) in the study and the control group respectively. Other perinatal complications were mentioned in Table 6 but no difference was recorded. Fetal measurements were done by ultrasound during the last week before delivery (Table 7). All measurements were clearly greater in macrosomic fetuses. Table 8 showed newborns' outcomes and their complications. The incidences of male babies were recorded more in macrosomic newborns (p=0.0001). The general condition of newborns in form of Apgar score in 1st and 5th minutes was similar in both groups. Neonatal hyperbilirubinemia and

infections were more frequent in the study group but neonatal hypoglycemia and admission to intensive care unit were more often in the control group. There was no significant difference in neonatal injuries and other neonatal diseases between both groups.

DISCUSSION

Macrosomia is still a problem in obstetric practice. The incidence of macrosomia in general population ranges from 6 to 14.4% depending on authors and definitions (Sukran *et al.* 2004). We analyzed the frequency of macrosomia in our Department in 2004 and the rate of macrosomia was 7.7% (Malinowska-Polubiec *et al.* 2004). There are many maternal risk factors that are associated with this obstetric complication. Identification of such factors in pregnancy will enable prediction and prevention of complications related to macrosomia. In our study socioeconomic status was not one of these factors. Maternal pre-pregnancy weight, height, weight gain during pregnancy, age and parity are all positively associated with neonatal birth weight. Around

Tab. 5. Data of current pregnancy.

Data of current pregnancy	Control group n (%)	Study group n (%)	*p*-value
Hospitalization rate:			
1	22 (6.7%)	41 (8.1%)	ns
>1	14 (4.2%)	9 (1.8%)	
Threatened abortion	31 (9.4%)	24 (4.7%)	0.012
Cervical insufficiency:			
cervical sutures	0	2	
pessary	19	7	0.0016
without sutures/pessary	0	2	
Oral tocolysis	15	14	ns
Intravenous tocolysis	18	6	0.0006
Steroids	12	6	0.0314
PPH	12 (3.6%)	16 (3.1%)	ns
PIH	17 (5.2%)	20 (4%)	ns
DM:			
GDM G1	42 (12.7%)	58 (17.6%)	ns
GDM G2	4 (1.2%)	9 (1.8%)	ns
PGDM	5 (1.5%)	9 (1.8%)	ns
Intrahepatic cholestasis	17 (5.2%)	12 (2.4%)	0.043
Polihydroamnion	1 (0.3%)	3 (0.6%)	ns
Oligohydroamnion	2 (0.6%)	3 (0.6%)	ns
Anemia	53 (16.1%)	67 (13.2%)	ns
Genital tract infection	21 (6.4%)	50 (9.8%)	ns
Urinary tract infection	19 (5.8%)	33 (6.4%)	ns
Other infections	14 (4.2%)	35 (6.9%)	ns
Hyperthyroidism	5 (1.5%)	0	
Hypothyroidism	15 (4.5%)	1 (0.2%)	0.00001
Goiter	5 (1.5%)	1 (0.2%)	

Tab. 6. Data of delivery.

Delivery data	Control group Mean ± SD [min–max] or n(%)	Study group Mean ± SD [min–max] or n(%)	*p*-value
Gestational age at delivery (weeks)	38.9±1.2	39.6±1.2	0.0001
Labor induction:			
spontaneous delivery	263 (79.7%)	410 (80.7%)	
prostaglandins	18 (5.5%)	30 (5.9%)	ns
oxytocin	43 (13%)	57 (11.2%)	
both	6 (1.8)	11 (2.1%)	
Number of inductions:	(n=67)	(n=98)	
1	56 (83.6%)	79 (80.6%)	ns
2	7 (10.4%)	13 (13.3%)	
>2	4 (6%)	6 (6.1%)	
Mode of delivery:			
normal vaginal	275 (83.3%)	321 (63.2%)	0.00001
cesarean section	44 (13.3%)	178 (35%)	
vacuum/forceps	11 (3.3%)	9 (1.8%)	
Elective cesarean	18 (40.9%)	65 (36.5%)	ns
Cesarean section in labor	26 (59.1%)	113 (63.5%)	ns
Indications for cc:			
emergency cc	20 (45.4%)	25 (14%)	
cephalic pelvic disproportion	3 (6.8%)	91 (51.1%)	0.00001
no progress in I and II stage	8 (18.1%)	50 (28.1%)	
other indications	13 (29.5%)	12 (6.7%)	
I stage(min)	334±161 35-998	371±176 45-1080	0.01
II stage (min)	32.8±30	34.5±32.4	ns
III stage (min)	8.9±4.6	9.6±5.3	ns
Amount of blood loss (ml)	361.5±84.1	415±183	0.0001
PROM	257	348	0.004
Duration of PROM (h)	5.75±5.2	4.2±4	ns
Color of amniotic fluid:			
clear	307 (93%)	428 (84.3%)	
meconium-stained	21 (6.4%)	76 (15%)	0.0015
blood-stained	2 (0.6%)	3(0.6%)	
Shoulder dystocia	1 (0.3%)	4 (0.8%)	ns
Infected cc wound	0	5 (2.8%)	ns
Infection of episiotomy	0	1 (0.3%)	ns
Endometritis	0	1 (0.2%)	ns
Postpartum anemia	31 (9.4%)	52 (10.2%)	ns
Incomplete placenta and/ or fetal membranes	37 (12.(%)	38 (11.5%)	ns
Postpartum hemorrhage in III, IV stages	2 (0.7%)	12 (3.6%)	ns
Subatonic uterus	0	2	ns
Postpartum fever	0	5	ns
Hysterectomy around delivery	0	1	ns

30% of mothers above 45 years give birth to newborns weighted more than 90 centile (Dildy *et al.* 1996). Macrosomia was more frequently observed in mothers with high BMI (Abenhaim *et al.* 2007, Hosseini and Nastaran 2004). Mothers with BMI >40 kg/m^2 had three fold more risk to deliver macrosomic baby. Other authors documented that maternal obesity before pregnancy was independent risk factor for fetal macrosomia (Ehrenberg *et al.* 2004; Goodall *et al.* 2005; Khasan & Kenny 2009; Stotland *et al.* 2004). Excessive pregnancy weight gain is associated with higher risk of macrosomia – from 1.4 to 15.2% (Bérard *et al.* 1998; Rhodes *et al.* 2003). The likelihood of macrosomia was greater if the mother was obese before pregnancy, multiparous and of older age (Jolly *et al.* 2003; Sadeh-Mestechkin *et al.* 2008; Zhang *et al.* 2008). Our data confirmed this observation. Mean maternal age in the study group was 30.3±4.6 versus 29.6±4.6 years in the control group (p=0.033). All maternal anthropometric measurements as weight, BMI, pregnancy weight gain, abdominal circumference and fundal height differed significantly between both groups. Mothers of macrosomic babies were heavier, had higher BMI as well as higher pregnancy weight gain. Babinszki *et al.* (Babinszki *et al.* 1999) observed that multiparous mothers had greater risk to deliver macrosomic babies. Abortion, preterm delivery and cesarean section in obstetric history did not increase the risk of macrosomia in our data.

The incidence of macrosomia in diabetes is ten times greater (Bręborowicz 2010). Although the majority of macrosomic babies are born to non-diabetic mothers, gestational diabetes remains a well-established risk factor (Esakoff *et al.* 2009; Kwik *et al.* 2007). The rate of macrosomia in women with gestational diabetes ranges between 30 and 50%, in women with pre-gestational diabetes the rate of macrosomia is about 26% – mainly in class B and C (Bręborowicz 2010). In our data, there were no significant differences in the rate of macrosomia according to classes of diabetes. The possible explanation may be the strict and firm antenatal care of diabetic mothers in our Department, and in addition – planned earlier delivery. In the current study, hypothyroidism and gestational cholestasis occurred more frequently in the control group. Probably early induction of labor in patients with cholestasis decreased the risk of macrosomia.

Mean gestational age of delivery was higher in study group. According to the literature, prolonged pregnancy increases risk of macrosomia (Jolly *et al.* 2003). 20% of newborns delivered after 42 weeks had birth weight greater than 4 000 grams and 3% – greater than 4 500 grams (Jolly *et al.* 2003). In our study, patients who suffered from threatened abortion or threatened preterm delivery less frequent deliver macrosomic babies.

Macrosomia can be recognized clinically or by ultrasound. Some authors compared ultrasound estimation, clinical estimation and self-estimation of birth weight (Halaska *et al.* 2006). The contribution of ultrasound, added to routine clinical estimation of fetal weight, was clinically insignificant apart from a further increase in cesarean section rate (Weiner *et al.* 2002). In our study, clinical measures (fundal height and abdominal circumference) were significantly bigger in macrosomic group than in control group.

Some authors concluded that higher amniotic fluid index was connected with higher prevalence of macrosomia (Hackmon *et al.* 2007, Shinoglu *et al.* 2003). Shi-

Tab. 7. Data of fetal measurements in ultrasound.

USG	Control group Mean ± SD [min–max]	Study group Mean ± SD [min–max]	*p*-value
BPD (mm)	92.3±4.0 76-102	101±2.8 84-105	0.00001
HC (mm)	321.0±13.3 275-359	345.8±9.9 319-380	0.0001
AC (mm)	329.0±18.0 265-358	364.6±15.7 302-408	0.00001
FL (mm)	71.7±3.7 62-68	77.3±3.2 68-88	0.00001
AFI (cm)	10.8±3.8	9.8±4.1	ns
EFW (g)	3 149±354 1 908–4 000	3 919±313 2 800–4 580	0.00001

Tab. 8. Neonatal data.

Neonatal data	Control group Mean ± SD [min–max] or n(%)	Study group Mean ± SD [min–max] or n(%)	*p*-value
Sex:			
female	175 (53%)	151 (29.7%)	
male	155 (47%)	357 (70.3%)	0.0001
Apgar 1st minute:			
0–3	0	2 (0.4%)	
4–7	6 (1.8%)	15 (3%)	ns
8–10	324 (98.2%)	491 (96.5%)	
Apgar 5th minute:			
0–3	1 (0.3%)	0	
4–7	0	3 (0.6%)	ns
8–10	329 (99.6%)	505 (99.4%)	
Neonatal care unit	11 (3.3%)	6 (1.9%)	0.03
Infections	10 (3%)	60 (11.8%)	0.00001
Fetal trauma:			
clavicle fracture	2 (0.6%)	14 (2.7%)	
IVH	5 (1.5%)	3 (0.6%)	
cranial hematoma	7 (2.1%)	10 (2%)	ns
brachial plexus injury	0	1 (0.2%)	
Breathing disorders	5 (1.5%	17 (3.3%)	ns
Hypoglycemia	52 (15.8%)	11 (2.2%)	0.00001
Hyperbilirubinemia	33 (10%)	136 (26.8%)	0.00001

noglu *et al.* (Shinoglu *et al.* 2003) mentioned that AFI cut off value differ in population. In Turkish population the AFI cut off value was 17 cm. When AFI was <17 cm, mean birth weight was 3 296.71 grams, and if AFI was ≥17 cm, mean birth weight was 3 970.2 grams. In our study we cannot confirm this relationship.

We revealed that 83.3% of control group patients delivered vaginally compared to 62.3% of macrosomic group. This finding was consistent with another studies (Conway 2002; Weiner *et al.* 2002). The indications for cesarean section were not similar in the two groups. In the study group more cesarean sections were due to cephalo-pelvic disproportion or prolonged stage of labor. In control group, cesarean was performed as emergency. According to study of Siggelkow *et al.* (Siggelkow *et al.* 2008) prolonged labor due to macrosomia led to obstructed labor and then to cesarean section. Other labor characteristics did not show any significant difference between both groups except prolonged first stage of labor and increased blood loss occurred in association with macrosomia. In current study there was no statistical difference between both groups according to postpartum maternal complications like infections, fever, anemia, postpartum hemorrhage and operative interventions. Other publications noted that in cases of macrosomia, there was increased risk of uterine atony, placental retention, bladder injury and postpartum infections (endometritis, urinary tract infection and wound infection). Most clinical conditions were rare (less than 1%) regardless of the method of delivery or infant weight, except shoulder dystocia, postpartum hemorrhage and postpartum infections (Gregory *et al.* 1998; Oral *et al.* 2001; Raio *et al.* 2002). In addition prolonged hospitalization after delivery was noted in patients with macrosomic newborn (Stotland *et al.* 2004).

There were significantly more males in the study group comparing to the control group in our study. This finding was also reported in study of Gillean et al (Gillean 2005). Most studies mentioned the birth trauma like clavicle or humorous fracture, Erb's palsy and hematoma in macrosomic babies (Mulik *et al.* 2003; Oral *et al.* 2001; Stotland *et al.* 2004; Wollschlaeger *et al.* 1999). Our data showed that there was no difference between both groups according to Apgar score and neonatal birth trauma. Macrosomic newborns seem to be the group of higher risk of hiperbilirubinemia and neonatal infections whereas hypoglycemia was observed more often in the control group. The rate of transfer to intensive care unit was more frequent among newborns in the control group.

In summary, macrosomia is found more often in older obese multiparas. When birthweight is 4 200 grams or more, the number of cesarean section increases. The main indications for cesarean section in cases of macrosomia are cephalo-pelvic disproportion and obstructed labor. Macrosomia is more often in male fetuses.

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