Perinatal Outcomes among Cases of Predicted and Unpredicted Macrosomia

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ABSTRACT

OBJECTIVE: Macrosomia is strongly associated with a range of adverse maternal and neonatal outcomes. The effectiveness of screening remains controversial because expecting a macrosomic fetus affects intrapartum management, promoting elective cesarean sections. This study aims to identify differences in outcomes and management among cases with predicted and unpredicted macrosomia.

STUDY DESIGN: This is a retrospective study of 779 live-born, cephalic, singleton macrosomic babies delivered at our institution from January 2017 to December 2019. Cases of macrosomia were categorized as unpredicted and predicted. Ultrasonographic weight predictions are made using the Hadlock formula. Data regarding mode of delivery, shoulder dystocia, perineal trauma, episiotomy use, and postpartum hemorrhage were retrieved. Data were stored in a secure database. The review board of the institution approved the study. Statistical analysis is performed utilizing the Mann-Whitney U test for continuous data, the chi-square test for cardinal variables, and logistic regression analysis. Significance was set as $p<0.05$.

RESULTS: Macrosomia is successfully predicted in 268 (34.4%) women. The rate of cesarean sections was significantly higher in the predicted group (46.4% vs. 35.4%, $p=0.002$). The higher rate of elective cesarean sections among women with predicted macrosomia (26.1% vs. 15.1%, $p=0.02$) contributed to this difference. Women with predicted macrosomic fetuses were more prone to perineal traumas, such as episiotomy (48.9% vs. 31.3%) or third/4th -degree lacerations (4.8% vs. 1.95%). Shoulder dystocia and other neonatal complications did not differ significantly among the groups.

CONCLUSION: Acknowledging macrosomia before delivery increases elective cesarean sections and it decreases the rate of adverse neonatal outcomes such as birth asphyxia.

Keywords: Cesarean section, Hadlock, Macrosomia, Ultrasound weight prediction

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Introduction

Fetal macrosomia rates are rising and account for more than 9% of deliveries lately (1-3). Macrosomia, defined as a fetus weighing 4000 grams or more (4-6), is strongly associated with a range of adverse maternal and neonatal outcomes such as postpartum hemorrhage, shoulder dystocia, birth injuries, and cesarean sections (7,8). Ultrasound-estimated fetal weight (EFW), first described in 1975 (9), remains the most common fetal weight estimation method (10), but the effectiveness of screening for macrosomia remains controversial (11). Moreover, expecting a macrosomia fetus affects intrapartum management, promoting elective cesarean sections as the preferred mode of delivery (12).

This study aims to identify differences in outcomes and management among cases with predicted and unpredicted macrosomia.

Material and Method

This is a retrospective study of 779 live-born singleton macrosomic babies delivered at the University Hospital of Obstetrics and Gynecology "Koco Gliozheni" over a three-year period (from January 2017 to December 2019). Multiple gestation and non-vertex presentations served as exclusion criteria. Women, who had a cesarean section planned for reasons other than macrosomia, were also excluded from the study. By definition, a macrosomic fetus weighs 4000 grams or more (4-6). Cases with an ultrasound EFW of 4000 grams or more within two weeks of delivery were categorized as 'predicted cases.' Ultrasonographic weight predictions are made using the Hadlock formula (DBP, HC, AC, and FL measurements in conjunction with last menstrual periods and gestational age).

The study was reviewed and approved by the ethics committee of UHOG "Koco Gliozheni" (Ethics approval reference number: 1329/date 21.11.2022). All procedures were performed according to the Declaration of Helsinki. Even though retrospective in nature, consent for using the data was gathered. Data regarding mode of delivery, shoulder dystocia, perineal trauma in the form of 3rd or 4th-degree lacerations, episiotomy use, postpartum hemorrhage (PPH, defined as blood loss of 500cc or more in vaginal deliveries or 1000cc in cesarean sections (13)), and birth asphyxia (defined by an Apgar score of zero to three for longer than five minutes) were retrieved from the patient files.

Other collected data included maternal constitutional parameters such as age, parity, and Body Mass Index (BMI). Data were stored in a secured database.

Statistics

Statistical analysis is performed with the XLMiner extension pack for Excel 2016, developed by Analytic Solver Data Mining. Mann-Whitney U test was utilized for continuous variables, whereas chi-square and Fisher's exact tests were performed for cardinal variables. Logistic regression is used to quantify the effect of weight prediction in adverse outcomes such as elective cesarean section rates, shoulder dystocia, and birth injuries. Significance was set as $p<0.05$.

Results

Overall, 779 patients with macrosomic newborns are included in the study. Macrosomia is successfully predicted in 268 (34.4%) women. Consequently, 511 (65.6%) women were unaware of the fetal weight before delivery.

The baseline characteristics of the patients are presented in table I. As shown, no statistically significant differences were noted between the two groups.

Moreover, maternal and neonatal adverse outcomes are depicted in table II and table III, respectively. The rate of cesarean sections was significantly higher in the predicted group (46.4% vs. 35.4%, ***p***=0.002). The higher rate of elective cesarean sections among women with predicted macrosomia (26.1% vs. 15.1%, ***p***=0.02) contributed to this difference.

Table I: *Baseline characteristics of patients categorized in predicted and unpredicted macrosomia groups*

	Predicted (n=268 (34.4%))	Unpredicted (n=511 (65.6%))	*p**
Maternal age (mean)	30.14+/-5.01	30.08 +/- 5.28	0.95
>35 years	57 (21.3%)	101 (19.8%)	0.62
Primiparous	103 (38.4%)	199 (38.9%)	0.88
Gestational Diabetes	6 (2.23%)	10 (1.95%)	0.79
Maternal BMI	29.06 +/- 3.76	29.3 +/- 3.45	
BMI > 30	107 (40%)	210 (41.1%)	0.75
BMI: body mass index			

Mann - Whitney U test was used for continuous variables such as age, and BMI.
**Statistically significant values at p<0.05 (Chi-square).*

Table II: *Maternal outcomes in the predicted and unpredicted macrosomia groups*

	Predicted (n=268)	Unpredicted (n=511)	*p**
Cesarean Section	125 (46.4%)	181 (35.4%)	0.002
Elective CS	70 (26.1%)	77 (15.1%)	0.02
Emergency CS	55 (20.5%)	104 (20.4%)	0.002
Vaginal Delivery	143 (53.4%)	330 (64.6%)	
Episiotomy	131 (48.9%)	160 (31.3%)	<0.001
Perineal lacerations	13 (4.8%)	10 (1.95%)	0.02
PPH	4 (1.63%)	17 (3.33%)	0.1

PPH: Postpartum hemorrhage; CS: Cesarean section
**Statistically significant values at p<0.05 (Chi-square).*

***Table III**: Neonatal outcomes in the predicted and unpredicted macrosomia groups*

	Predicted (n=268)	Unpredicted (n=511)	*p**
Fetal Weight (mean)	4291+/-298.5	4174+/-189.9	<0.05
>4500 grams	59 (22%)	32 (6.3%)	<0.001
Shoulder Dystocia	11 (4.1%)	26 (5%)	0.54
Birth Asphyxia	5 (1.7%)	25 (4.9%)	0.04
NICU	22 (8.2%)	51 (10%)	0.42
Cephalhematoma	15 (5.6%)	39 (7.6%)	0.28

Mann - Whitney U test was used for fetal weight.
**Statistically significant values at p<0.05 (Chi-square).*

Women with predicted macrosomic fetuses were more prone to perineal traumas, such as episiotomy (48.9% vs. 31.3%) or third/4th-degree lacerations (4.8% vs 1.95%).

Whilst postpartum hemorrhage was less likely to occur in the predicted group (1.63% vs 3.33%, p=0.100); this finding is not statistically significant. Moreover, when we excluded elective c-sections from the analysis, no evident difference was found between the groups.

Mean birth weight was higher in the predicted macrosomia group than in the unpredicted group.

On the other hand, shoulder dystocia (4.1% vs. 5%, p=0.54), and other neonatal complications did not differ significantly among the groups.

To evaluate the independent contribution of predicted fetal weight in adverse outcomes such as elective cesarean sections, shoulder dystocia, and birth injuries, models of multiple logistic regressions were employed. Possible confounding factors such as maternal age, parity, gestational diabetes, birth weight >4500 grams, and BMI were entered into the calculations. The results of this analysis are presented in table number IV.

***Table IV:** Association of predicted macrosomia with adverse maternal and neonatal outcomes: logistic regression analysis*

	Predicted macrosomia Adjusted OR (95% CI), *p*
Elective Cesarean Sections	1.66 (1.12-2.47), p=0.01
Shoulder Dystocia	0.54 (0.24-1.19), p=0.13
Birth Injuries	2.36 (0.98-5.72), p=0.06

**Statistically significant values at p<0.05*

Discussion

In this study, we compared cases of predicted and unpredicted macrosomia and concluded that expecting a macrosomic fetus influences the decision regarding the mode of birth. Elective cesarean sections are significantly higher in the predicted group, even when adjusting for confounding factors. Similarly, episiotomy rates were also higher in the predicted group. Other studies also note such correlations (14-17). Authors suggest that elective cesarean sections reduce complications related to the delivery of a macrosomic baby (18). Thus, this approach is recommended for delivering fetuses >4500 grams in diabetic patients or >5000 grams in women without diabetes (19-20). Another alternative is labor induction at term to stop further fetal growth (21,22). Cochrane published a review demonstrating that labor induction protects from shoulder dystocia (23). Cons to this approach is the increase of emergency cesarean sections noted amongst cases of induced labor (24-26).

Consequently, there still needs to be a consensus and protocol about managing macrosomia cases. Similarly, our institution does not have any guidelines, though it is common practice to plan a cesarean section for women with EFW of more than 4500 grams. Induction of labor is done when macrosomia is predicted in non-diabetic women at term, whilst cesarean section is again preferred when it comes to diabetic mothers. Ultimately, there is no protocol in place in our institution regarding macrosomia. The above-mentioned are methods employed by different providers and thus remain subject to their preferences.

Again, the decision should be two-sided, with women part of the discussion and the decision-making process.

Episiotomy rates are also inflated in the predicted group. Similarly, there are no protocols concerning the use of episiotomy in our institution, and the decision is left entirely to the provider. However, the general opinion is that it serves as a protective factor against possible lacerations (28). The predicted group has a statistically higher mean fetal weight and ratio of babies weighing more than 4500 grams, therefore this inadequacy should be pointed out as a possible confounding factor when interpreting results.

Contrary to Venditelli et al. reporting a 1.8-fold increase in traumatic injuries, shoulder dystocia included, in the cases of predicted macrosomia (15), our study does not show significant differences regarding lacerations and shoulder dystocia rates.

While it is proved that macrosomia increases the risk of shoulder dystocia (28-30), predicting fetal weight has not been

shown to decrease its occurrence rates during vaginal deliveries (1,12).

The retrospective nature of the study limits the availability of data, especially regarding possible long-term complications of the newborn.

Macrosomia is correctly predicted in 34.4% of cases in our study. Hadlock, published in 1991, is the most used formula for fetal weight prediction (32). While literature describes a variety of proposed formulas to estimate fetal weight, authors like Shmueli et al., Bryant et al., Benson et al., and Siemer et al., to name a few, found Hadlock to be the most accurate (33-36).

Nevertheless, all tests have their limitations, and when it comes to macrosomia, they have more probability of correctly ruling it out than ruling it in (10). Other factors affecting the test's predictive value include amniotic fluid volume, fetal position, and fetal adipose tissue depth.

Nor these, nor maternal factors, such as weight gain, were considered when applying fetal weight measurements in our cohort.

Another limitation is the fact that different physicians performed ultrasound weight estimation. Therefore, even though all fetal weight estimations use the Hadlock formula, the accuracy of weight prediction depends on the ultrasound technique and the technicians' experience and skills (10,31).

Estimated fetal weight calculated within two weeks of delivery translates into weight differences of 300-400 grams if delivery happens after 14 days. This may partly explain the low percentage of macrosomia prediction. Timing from the moment of EFW and delivery was not taken into consideration as a variable of the study.

The small sample size may limit result availability and representation. On the contrary, the data derived from the same institution minimizes biases regarding the definition of cases and management differences.

In conclusion, fetal weight estimation remains an essential tool in optimizing the management of macrosomic cases. Furthermore, its acknowledgment promotes the preparedness of staff, which are made aware of possible obstetric emergencies that may arise and thus can fastly take action.

Further national studies may be required to help make a guideline to guide the delivery decisions and further minimize adverse outcomes.

Another area of interest is the optimization of fetal weight estimation.

Conclusion

Even though acknowledging macrosomia before delivery increases cesarean section births, it decreases the rate of adverse neonatal outcomes such as birth asphyxia.

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Author Contribution: Merita Isaku conceived the presented idea, designed and performed the experiments, derived the models, and analyzed the data. Enxhi Vrapi and Redi Hoxhallari engaged in writing the manuscript and the statistical analysis. Tedi Bimbashi reviewed the ultrasound data to produce accurate weight estimations. Ina Cala and Kizjona Perdja gathered data and compiled the final database. Astrit Bimbashi reviewed the final manuscript. All authors discussed the results and contributed to the final manuscript.
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