The Influence of Fetal Head Circumference and Fetal Weight Measurement Assessed By Intrapartum Ultrasound on Labor Outcome

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ABSTRACT
Background: labor is a clinical diagnosis characterized by regular, painful uterine contractions that increase in frequency and intensity is associated with progressive cervical effacement or dilatation. More specifically, it is associated with a change in the myometrial contractility pattern from irregular "contractures" (long-lasting, low-frequency activity) to regular "contractions" (high-intensity, high frequency activity).
Aim of the work: it was to determine if fetal head circumference and fetal weight could predict the rate of caesarian section and operative vaginal deliveries in nulliparous women in labor.
Patients and Methods: this study was carried out at Al Alamein Hospital from January 2017 to January 2018 on two hundred (200) primigravida women; their ages ranged from 20 to 30 years and the gestational ages ranged from 38-40 weeks with normal singleton pregnancy with cephalic presentation in labor.
Results: there were highly statistically significant relations between mode of delivery and fetal head circumference and estimated fetal weight as p value (0.001).it was found that large fetal head circumference relative to maternal pelvic diameter is the main cause of prolonged labor and therefor increased risk of primary caesarian section.
Conclusion: the numerical data have a significant relation between intra partum head circumference and fetal weight and the incidence of primary caesarian section, maternal and fetal complications.
Recommendations: according to numerical results obtained from this study. The study recommends strict labor monitoring by partogram in cases where fetal head circumference is more than 35cm or fetal weight is more than 3950gms.
Keywords: fetal head circumference, fetal weight, intrapartum ultrasound, labor outcome.

INTRODUCTION

Birth represents one of the most important of all the experiences of the human kind. Despite the complexity and sophistication of modern obstetrics it is important to remember the simple objective of every pregnancy, namely the delivery of a healthy baby to a healthy mother. The fullest possible understanding of the birth process, its perturbations and appropriate management policies is central to that objective [1].One of these complexities is prolonged labour, operative delivery procedures arising from prolonged labor increase maternal morbidity, fetal morbidity, and the cost of care. Cephalopelvic disproportion (CPD), due to narrow maternal pelvic diameter relative to fetal head circumference (FHC) or large FHC relative to maternal pelvic diameter, is the main cause of prolonged labor [2]. High birth weight increases the risk of prolonged labor [3], and instrumental or operative delivery [4]. A consistent increase in the mean birth weight and in the proportion of fetal macrosomia, defined as a birth weight greater than 4000 g, has been reported since

the 1980s [5]. Primary concern about the birth of a macrocosmic fetus is adverse neonatal outcomes including stillbirth and neonatal mortality secondary to birth asphyxia, shoulder dystocia, birth injury, metabolic disorders, and meconium aspiration syndrome [6].Similarly, maternal complications are increased in the setting of fetal macrosomia [7].Maternal risks include birth canal and pelvic floor injuries, increased rate of operative vaginal and caesarean deliveries, and postpartum hemorrhage [8]. Birth weight of an infant is the single most important determinant of newborn survival [9]. Limiting the potential complications associated with the birth of excessively large fetuses requires that accurate estimation of fetal weight occurs before decision to deliver is made [10].The two main methods for predicting birth weight in current obstetrics are clinical and ultrasonographic methods [11]. Increasing attention is being paid to the accuracy of using various ultrasound measurements in estimating fetal head circumference and fetal weight. Ultrasound could be useful for decreasing the number of C-sections performed defensively by obstetricians who wish to avoid the possibility of a complicated delivery [12].

AIM OF THE WORK

The aim of the present study is to determine if fetal head circumference and fetal weight could predict the rate of caesarian section and operative vaginal deliveries in nulliparous women in labor.

PATIENTS AND METHODS

Settings:
The study is a prospective cohort study that was conducted at Al Alamein hospital at Maternity Labor ward from January 2017 to January 2018.

Methods:
Two hundred pregnant parturient admitted to the labor ward of Al Alamein Hospital for delivery were subjected to inclusion criteria of the study.

The study was approved by the Ethics Board of Al-Azhar University.

Inclusion criteria:
• Written consent always preceded inclusion.
• Maternal age between 20 to 30 years old
• All parturients were primigravidas
• Normal singleton pregnancies
• Cephalic presentation in labour with gestational age between 38 to 40 weeks.
• No congenital fetal abnormalities detected by U/S.

Exclusion criteria:
• Maternal age less than 20 and more than 30 years old.
• Multigravidas and multiple pregnancies.
• Malpresented foetuses.
• Gestational age less than 38weeks.
• Women with uncertain gestational age, intrauterine fetal deaths and fetal anomalies were excluded.
• Those who had elective or emergency caesarean section for indications such as antepartum hemorrhage, preeclampsia/eclampsia, poorly controlled diabetes mellitus and other medical disorders of pregnancy prior to onset of labour were also excluded.

The following was applied to all women included in the current study:
• Evaluation of full obstetric history.
• General examination as regard general condition and vital data.
• Abdominal examination as regard fundal level, fetal position
• Fetal heart rate monitoring by CTG

• Vaginal examination as regard cervical dilatation, effacement and state of membranes.
• According to the hospital standards in the labor room, patients were managed.

All women included in the current study were examined by trans-abdominal ultrasound using Mindray dp2200 set in labor ward to measure the fetal head circumference and fetal weight.Fetal weight was estimated by measuring 4 biometric indices which are abdominal circumference (AC) biparital diameter (BPD) femur length (FL) and head circumference (HC).

Medical consideration:

Patient information and informed consent

After approval of the ethical committee, all participants in the study were given a written, informed consent, after explaining the details of the study to them.

Data management and statistical analysis
Data was presented as mean and standard deviation (± SD) for quantitative parametric data, and Median and Interquartile range for quantitative non parametric data. Frequency and percentage was used for presenting qualitative data. Suitable analysis was done according to the type of data obtained. Student T Test or Mann Whitney test was used to analyze quantitative data while chi square test and fisher exact test was used to analyze qualitative data. P- value: level of significance.

RESULTS

Table (1): Mode of delivery in the studied group

	Frequency (No.)	Percent
Cesarean section	64	32.0
Vaginal delivery	136	68.0
Total	200	100.0

Table (1), shows the mode of delivery in the studied group. It was found that the cesarean section was in 32% of cases while vaginal delivery was in 68% of cases.

Table (2): Maternal complications, in the studied patients group

	Frequency (No)	Percent
No complications	160	80
Birth canal or pelvic floor injuries	26	13
Post-partum hemorrhage	14	7
Total	200	100.0

Table (2), shows the maternal complications, 80% of cases had no complication, while the other 20% had complications.

Table (3): Relation between mode of delivery and different neonatal measurements.

		Min.	Max.	Mean	S.D.	t-test	P
Intrapartum fetal head circumference (cm)	Cesarean section	31.9	37.00	34.96	1.87	74.074	0.0001*
	Vaginal delivery	30.8	37.00	32.50	1.89		
estimated fetal weight by ultrasound (gm.)	Cesarean section	3660.00	4200.00	3950.47	154.24	10.583	0.0001*
	Vaginal delivery	2500.00	4200.00	3395.59	482.47		
Neonatal head circumference (cm)	Cesarean section	32.40	38.00	36.95	1.55	19.607	0.0001*
	Vaginal delivery	31.70	38.00	34.35	1.70		
Actual Fetal weight (gm.)	Cesarean section	3690.00	4230.00	3973.44	153.61	12.607	0.0001*
	vaginal delivery	2520.00	4220.00	3422.13	482.38		

(Min. =minimum, Max. =maximum, S.D. =standard deviation, t-test =student t-test, p. =p. value)

Table (3), shows relation between mode of delivery and different neonatal measurements. There was positive relation between mode of delivery and different neonatal measurements which was highly significant (P < 0.05).

Table (4):Relation between Maternal Complication and Mode of delivery

			Mode of delivery		Total
			Cesarean section	Vaginal delivery	
Maternal Complication	No complications	No.	61	99	160
		%	95.3%	72.8%	80.0%
	Birth canal or pelvic floor injuries	No.	0	26	26
		%	0.0%	19.1 %	13.0 %
	Post-partum hemorrhage	No.	3	11	14
		%	4.7%	8.1 %	7.0%
Total		No.	64	136	200
		%	100.0%	100.0%	100.0%
X^2			8.02		
P			0.028*		

(X^2=chi square, p. =p. value)

Table (4), shows relation between Maternal Complication and Mode of delivery. There was a statistical significant relation between maternal complication and mode of delivery (P < 0.05).

Table (5): Cut off value and the specificity and sensitivity of Head Circumference in detect the mode of delivery

Area under the curve	Cut off value	Sensitivity	Specificity	PPV	NPV	Accuracy
0.84	35.0 Cm	85.0%	92.6%	90.0%	94.0%	89.0%

Table (5), show the cut off value of head circumference to predict the mode of delivery, at 35.0 cm the sensitivity in detect the CS delivery was 85.0% and the specificity was 92.6%, the positive predictive value was 90.0% and the negative predictive value was 94.0%, the accuracy was 89.0%.

Table (6): Cut off value and the specificity and sensitivity of estimated fetal weight in detect the mode of delivery.

Area under the curve	Cut off value	Sensitivity	Specificity	PPV	NPV	Accuracy
0.846	3950	86.0	89.0	80.0	84.0	82

Table (6), show the cut off value of fetal weight to predict the mode of delivery, at 3950 gm. the sensitivity in detect the CS delivery was 86.0% and the specificity was 89.0%, the positive predictive value was 80.0% and the negative predictive value was 84%, the accuracy was 82%.

Table (7): Intrapartum fetal head circumference (cm) distribution.

Intrapartum fetal head circumference	Frequency	Percent
<35	145	72.5
>35	55	27.5
Total	200	100.0

Table (7), shows that, 72.5% of cases were less than 35 cm and 27.5% of cases were more than 35 cm.

Table (8): Estimated fetal weight by ultrasound (gm.)

estimated fetal weight by ultrasound (gm.)	Frequency	Percent
<3950	148	74.0
>3950	52	26.0
Total	200	100.0

Table (8), shows that, 74% of cases were less than 3950 gm and 26% of cases were more than 3950 cm.

Table (9): Relation between mode of delivery and Intrapartum fetal head circumference (cm)

			Intrapartum fetal head circumference (cm)		Total
			<35	>35	
Mode of delivery	Cesarean section	No.	23	41	64
		%	15.9%	74.5%	32.0%
	Vaginal delivery	No.	122	14	136
		%	84.1%	25.5%	68.0%
Total		No.	145	55	200
		%	100.0%	100.0%	100.0%
X^2 P			63.106 0.0001*		

(X^2=chi square, p. = p. value)

Table (9), shows relation between Mode of delivery and Intrapartum fetal head circumference. There was positive correlation between mode of delivery and Intrapartum fetal head circumference which was highly significant ($P < 0.05$).

Table (10): Relation between mode of delivery and estimated fetal weight by ultrasound (gm.)

			Estimated fetal weight by ultrasound (gm.)		Total
			<3950	>3950	
Mode of delivery	Cesarean section	No.	30	34	64
		%	20.3%	65.4%	32.0%
	Vaginal delivery	No.	118	18	136
		%	79.7%	34.6%	68.0%
Total		No.	148	52	200
		%	100.0%	100.0%	100.0%
X^2 P			35.992 0.0001*		

(X^2=chi square, p. = p. value.)

Table (10), shows relation between mode of delivery and estimated fetal weight by ultrasound. There was positive relation between mode of delivery and estimated fetal weight by ultrasound which was highly significant ($P < 0.05$).

DISCUSSION

A growing body of knowledge is accumulating regarding true intrapartum ultrasound, a relatively new application of ultrasound [13].

Intrapartum ultrasonography has enabled further understanding of the complex physiology of labor. It has been shown to provide objective data on the dynamics of various stages of labor, and has also been used to determine the prognosis for operative vaginal delivery [14].

The authors measured the head circumference within minutes of birth and assessed its predictive value on labor outcome. Infants with large FHC (37-41 CM) had 2.28-fold (95% confidence interval [CI]: 1.99, (R.R):2.61 increased risk of primary cesarean section, so the head circumference was a good predictor for incidence of primary caesarian section.

The present study assessed ultrasonographically the head circumference and fetal weight as predictive values on labor outcome. The receiver operator curve (ROC) showed that these were good predictors of mode of delivery (sensitivity of 85 % and specificity of 92.6 %).

In the present study the result showed that mean values of postpartum head circumference, birth weight, and gestational age were 35.2cm, 3598.6 kg,39.03 weeks respectively, with cesarean delivery rate is 15.9% with average fetal head circumference (below 35cm) and 74.5 % with large fetal head circumference (above 35cm).

This is in agreement with **Calder *et al.*** [15] who concluded that the mean values of post-partum head circumference, birth weight and gestational age were 34.8cm, 3.2 kg, and 39.5 weeks respectively. The cesarean delivery rate was 13.3% with average fetal head circumference(less than 37 cm) and 66.6 % with large fetal head circumference (more than 37 cm). It was a prospective study conducted at the university College Hospital at all term singleton cephalic deliveries, but uses postnatal measurements of head circumference on the second day of live it shows 37 cm is cut-off value.

In our study the cut off value of fetal weight to predict the mode of delivery was 3950 gm. The sensitivity in detection of the CS delivery was 86.0% and the specificity was 89.0%, the positive predictive value was 80.0% and the negative predictive value was 84, the accuracy was 82.0%., and there is a significant increase in the incidence of cesarian section with increase fetal weight above cut off value by 45.1% (p=0.0001).

Receiver Operator Characteristics curves (ROC) indicated that intrapartum fetal head circumference is 35cm and intrapartum fetal weight is 3950 kg are the best cut of levels for predicting the prolonged labor and consequent labor complications.

Cesarean delivery rate was 15.9% among 145 women with average fetal head circumference (less than 35 cm) and 74.5% among 55 women with large fetal head circumference (more than 35 cm).

Average fetal weight (less than 3950 kg) showed 20.3% incidence of caesarian section within 148 women and large fetal weight (>3950 kg) show 65.4% incidence of caesarian section among 52 women.

CONCLUSION

The numerical data have a significant relation between intra partum head circumference and fetal weight relative to maternal pelvic diameter and the incidence of primary caesarian section, maternal and fetal complications. So measurement of intrapartum head circumference and fetal weight are good predictors of labor outcome.

RECOMMENDATIONS

According to numerical results obtained from this study. The study recommends strict labor monitoring by partogram in cases where fetal head circumference is more than 35cm or fetal weight is more than 3950gms as these values represent the cut off values above which there is increased incidence of maternal and fetal complications.

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