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DOPPLER VELOCIMETRY OF THE FETAL MIDDLE CEREBRAL ARTERY, UMBILICAL AND UTERINE ARTERES IN THE PREDICTION OF PROLONGED PREGNANCY AND THEIR EFFECT ON NEONATAL OUTCOME

By

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ABSTRACT

Background: Although the increased fetal morbidity and mortality associated with post-term pregnancy has long been appreciated, most authors have studied gestational age as the alone contributing factor. The influence of other factors such as maternal age, parity, maternal smoking, fetal genders, birth weight and past history of post-term has not been adequately evaluated, Additionally, the accuracy of earlier studies is limited by the fact that they predate the widespread use of both ultrasonography for accurate gestational dating and intensive fetal testing to establish fetal wellbeing.

Objective: the present study was conducted to evaluate the effects of prolonged exceeding 287 days of menstrual age on the Doppler flow velocity waveforms in the umbilical, middle cerebral and uterine arteries, and its impact on neonatal outcome to determine the best predictor of adverse outcome in post-term.

Patients and Methods: The present study included 50 pregnant ladies All patients were submitted to ultrasound for detection of fetal genders, fetal weight and amniotic fluid index (AFI) Also, they were submitted to color Doppler velocimetery of fetoplacental and fetal vessels including middle cerebral pulsitility index MCA PI), umbilical artery pulsitility index UA PI), middle cerebral resistance index MCA RI), umbilical artery resistance index UA RI), uterine artery pulsitility index UtA PI),and uterine artery pulsitility index UtA RI).

Results: In the present study, there was no statistical signification with gestational age, fetal heart rate and parity. The primary gravida had the highest incidence. There was higher rate of CS which was significant with prolongation of pregnancy, but with no statistically significant difference between adverse and normal outcome Also, the incidence of males was more than females in our population with no significant relation between fetal gender and neonatal outcome. Adverse outcome was associated with lower MCA PI, MCA RI, AFI, Apgar score, and higher UA RI compared to normal outcome with statistically significant difference between them, but there was no statistically significant difference as regard UA PI, UtA PI, UtA RI.

Conclusion: The perinatal morbidity and mortality may be increase in post-term pregnancies. However, the all screening tests and Doppler indices may be normal due to mode of delivery, time of delivery, and type of anesthesia during labor. So, during labor, rapid interference should be taken to decrease incidence of adverse neonatal outcome. In post-term pregnancies with adverse outcomes, impedance to flow in umbilical arteries may be increased, while impedance to flow in the fetal middle cerebral arteries may be decreased, but impedance to flow in uterine arteries may be normal

Key words: Doppler velocimetry, prolonged pregnancy, neonatal outcome.

INTRODUCTION

Postdate pregnancy is a common problem. Its incidence has been reported to be between 2.5 – 12% with an average of 10.5% ***(Bakketeig and Bergsjo, 2000).***

A safe limit for continuation of pregnancy beyond expected date of delivery cannot be established as there is little agreement as to when exactly the fetal jeopardy begins. There is also controversy on whether risk of fetal hypoxia can be accurately predicted in these pregnancies. ***Rayburn and Chang (1997)*** suggested that risk of post maturity starts at 40 weeks. Postdate pregnancies have been associated with increased perinatal morbidity and mortality which increase after 42 weeks ***(Hollis, 2002).***

The American College of Obstetricians and Gynecologists, defines Post term pregnancy as ≥42 weeks of gestation (≥294 days from the first day of the last menstrual period ***(ACOG, 2013).***

Of note, full term is defined as 39 to 40weeks of gestation, and late term is to 41weeks of gestation ***(Spong, 2013).***

Increased incidence of induction of labor, instrumental delivery, cesarean section, shoulder dystocia, lower Apgar score, congenital malformations, meconium aspiration, and fetal asphyxia have been associated with these pregnancies ***(Hollis, 2002).***

These problems can be decreased by routine antepartum fetal surveillance prior to onset of spontaneous labor ***(Arias, 2000 and Shime et al., 2002).***

The current methods of fetal surveillance like non stress test (NST), amniotic fluid index (AFI), biophysical score (BPS), umbilical artery (UA) S/D ratio, and middle cerebral artery (MCA) pulsatility index (PI) cannot accurately predict fetus at risk of adverse perinatal outcome ***(Hollis, 2002).***

Various studies have investigated MCA and UA (CU ratio) in post-term pregnancies with high risk complicating factors like chronic hypertension, pregnancy induced hypertension (PIH) and diabetes, and found it to accurately predict fetal compromise. These conditions, however, are known to affect the vascular bed and placental circulation, and hence, the blood flow to the fetus. Very few studies have been done on the value of CU ratio in determining the perinatal outcome in low risk postdate pregnancies. Hence this study was designed to study the doppler waveforms in UA and MCA, and CU ratio in uncomplicated postdate pregnancies, and to correlate these findings with the perinatal outcome. It also aimed to determine the cutoff value of CU ratio for predicting adverse perinatal outcome in these pregnancies ***(Arias, 2000 and Gramellini et al., 2005).***

The aim of the work was to determine the value of the following fetal Doppler indices (Middle cerebral, Umbilical and Uterine arteries) assessment by ultrasound in pregnancies at or beyond 40 weeks of gestation, and correlate it with perinatal outcome.

PATIENTS AND METHODS

This was a prospective cross-sectional study including 50 pregnant women with gestational age ≥287 days since last menstrual period (LMP), admitted to Luxor international hospital for *Obstetrics and Gynecology*. All patients were

enrolled in the study after obtaining a written consent.

Inclusion criteria:

- Prim gravid or multi gravid with previous normal vaginal delivery.
- Single pregnancy in cephalic presentation with gestational age between 41-42 weeks.
- Intact membrane.
- Placenta fundal.
- Average amniotic fluid.
- Average fetal body weight.
- Routine FWB (biophysical profile) normal.

Exclusion criteria:

- Serious maternal illness.
- Cardiovascular diseases.
- Diabetes mellitus.
- Bronchial asthma.
- Pregnancy induced hypertension
- Severe anemia
- Multiple pregnancy and polyhydro-mnios
- Malpresentation

Patients were subjected to detailed history taking, clinical examination, C.B.C., Rh, blood grouping, blood sugar level, kidney functions test, liver Enzymes, complete urine analysis and culture sensitivity, and Doppler screening (middle cerebral artery, umbilical artery and uterine arteries).

Statistical analysis : Categorical variables were analyzed using chi^2 test with continuity correction. Numerical data were evaluated by using t-student test provided that the data had normal distribution.

Receiver operating characteristic (ROC) curve analysis was used to examine the value of Doppler indices for the prediction of adverse neonatal outcomes. The area under the ROC curve (AUC) was interpreted as follows: AUC 0.5 to 0.6, non-predictive; AUC 0.6 to 0.7, poor predictive value; AUC 0.7 to 0.8, fair predictive value; AUC 0.8 to 0.9, good predictive value; AUC 0.9 to 1.0, excellent predictive value. The DeLong method was used to compare the areas under various ROC curves the SPSS/PC+ statistical package (SPSS Inc, Chicago, IL) was used for all analysis. P value <0.05 was considered statistically significant, P value >0.05 was considered statistically insignificant.

Data were analyzed using IBM© SPSS© Statistics version 22 (IBM© Corp., Armonk, NY, USA) and MedCalc© version 13 (MedCalc© Software bvba, Ostend, Belgium) as follows:

- Continuous numerical variables were presented as mean (SD) and discrete variables as median (interquartile range).
- Categorical variables were presented as number (%).
- Continuous numerical variables were compared parametrically using the unpaired t test.
- The Welch test was used in place of the t test whenever equality of variance could not be assumed.
- The Mann-Whitney test was used to compare discrete variables.

- Categorical variables were compared using the Pearson chi-squared test or Fisher's exact test, when appropriate.

Sample size was calculated using **Epicalc 2000** software with the following inputs:

The minimal sample size was 100

- Type I error (α) =5% with confidence level 95%
- Study power 90 % (power of test) with type error II 10% (Beta)

The significance level (α) at 0.05.

RESULTS

Average age was 26 years, gestational age was 289 days, and primary gravida had the highest incidence (Table 1).

Table(1): Distribution of the studied group as regard general data.

Variables	Mean+SD	Range
Maternal age (yrs.)	26±5	18-37
Gestational age (days)	289±2	287-292
	NO.	**%**
Parity		
Primary gravida	22	44%
P1	10	20%
P2	9	18%
P3 or more	9	18%

P : number of delivery

In our study, 48% of the studied cases had spontaneous and assisted delivery, while 52% of the studied cases had CS delivery having higher rate (Table 2).

Table (2): Distribution of the studied group as regard mode of delivery.

Variables	No. (%)
Spontaneous vaginal delivery	14(28%)
Assisted delivery with induction	10 (20%)
Cesarean section	26 (52%)

Average fetal weight was 3.7 kg and ranged from 3.25 to 4.4 kg., males were 60%, while females were 40% (Table 3).

Table (3): Distribution of the studied group as regard fetal data.

Variables	NO.	%
Gender		
Male	30	60%
Female	20	40%
	Mean ± SD	**Range**
Fetal weight (gm.)	3738±270	3250-4400
Apgar 1 min.	7±2.7	3-10
Apgar 5 min.	8±2.	3-10

Average umbilical artery PI, RI were 0.71, 0.61, average MCA PI, MCA RI were 1.27, 0.72, average UtA PI, UtA RI were 0.74, and fetal heart rate was 130 beat/min (Table 4).

Table (4): Distribution of the studied group as regard hemodynamics

Variables	Mean+SD	Range
UA PI	0.71±0.08	0.60-0.98
UA RI	0.61±0.08	0.48-0.87
UtA PI	0.74±0.09	0.53-0.90
UtA RI	0.49±0.05	0.39-0.59
MCA PI	1.27±0.25	0.90-1.80
MCA RI	0.72±0.07	0.56-0.87
Fetal heart rate	130±19	100-160

The studied women had neonatal complications as meconium aspiration (12%) and asphyxia (4%) and (18%) of adverse neonates were admitted (Table 5).

Table (5): Distribution of the studied group as regard fetal complication.

Variables	NO. (%)
Cases without neonatal complication	34(68%)
Cases with neonatal complication	16(32%)
RDS	4(8%)
Hypothermia	5(10%)
MAS	6(12%)
Asphyxia	2(4%)
Birth hypoxia	3(6%)
CS for fetal distress	4(8%)
Neonatal Death	1 (2%)
NICU admission	9 (18%)
MAS: meconium aspiration syndrome. NICU : neonatal intensive care unit	RDS: respiratory distress syndrome. CS : cesarean section

32% of the studied women had maternal complications as prolonged labor (10%), retained placenta (6%) and cervical tears (4%) (Table 6).

Table (6): Distribution of the studied group as regard maternal complications.

Variables	NO. (%)
Cases without maternal complication	34 (68%)
Prolonged labor>expected time for 1st stage	5 (10%)
Postpartum hemorrhage	2(4%)
Perineal laceration	2 (4%)
Cervical tear	2 (4%)
Uterine Atony	2 (4%)
Rupture uterus	0 (0%)
Retained placenta	3 (6%)

Statistically significant difference could be detected between both groups (adverse and no adverse) as regard maternal age, gestational age and parity (Table 7).

Table (7): Characteristics of patients with or without adverse neonatal outcomes

Groups / Parameters	*No adverse neonatal outcomes (n=34)*	*Adverse neonatal outcomes (n=16)*	*p-value*
	Mean±SD		
Mother's age, years	26 (5)	25 (5)	0.734¶
Gestational age, days	289 (2)	290 (2)	0.096¶
	N0. (%)		
Parity(p)			0.532§
PG	15 (44.1%)	7 (43.8%)	
P1	8 (23.5%)	2 (12.5%)	
P2	6 (17.6%)	3 (18.8%)	
P3 or more	5 (14.7%)	4 (25.0%)	
PG = primary gravida.	P = number of delivery. ¶ Unpaired t test. §Chi- squared test for trend.		

Statistically significant difference between both groups (adverse and no adverse) as regard fetal weight and fetal heart rate, p-value was >0.05, but the group with adverse neonatal outcome had lower AFI compared to other group (no adverse neonatal outcome) with statistically highly significant difference between both groups using Mann-Whitney test (Table 8).

Table (8): Ultrasound findings in patients with or without adverse neonatal outcomes.

Groups / Parameters	**No adverse neonatal outcomes (n=34)**	**Adverse neonatal outcomes (n=16)**	**p-value**
	Median (interquartile range)		
AFI	8 (7 – 10)	6 (5 – 8)	**0.0002¶**
	Mean±SD		
Estimated fetal weight (g)	3743 (289)	3729 (234)	0.865§
Fetal heart rate (bpm)	132 (20)	125 (17)	0.241§
¶Mann-Whitney test.	§Unpaired t test.	AFI = amniotic fluid index	

Normal outcome (no adverse outcome) was associated with higher MCA-PI, MCA-RI, CPR, MCA-RI/U-RI, and lower UA-PI, U-RI, UtA-PI, UtA-RI compared to adverse outcome group, with statistically significant difference between normal and adverse outcome as regard MCA-PI, MCA-RI, UA-RI, CPR, MCA-RI/UA-RI ratio, but no significance as regards UA-PI, UtA-PI, UtA-RI by using Unpaired t-test (Table 9).

Table (9): Doppler indices of the middle cerebral, umbilical, and uterine arteries in patients with or without adverse neonatal outcomes.

Groups / **Parameters**	***No adverse neonatal outcomes (n=34)***	***Adverse neonatal outcomes (n=16)***	***p-value***
Middle cerebral artery PI	1.34 (0.27)	1.13 (0.16)	**0.00173**
Middle cerebral artery RI	0.74 (0.06)	0.68 (0.07)	**0.003**
Umbilical artery PI	0.70 (0.06)	0.73 (0.10)	>0.05
Umbilical artery RI	0.58 (0.05)	0.67 (0.08)	**<0.0001§**
Uterine artery PI	0.74 (0.09)	0.76 (0.08)	>0.05
Uterine artery RI	0.48 (0.05)	0.50 (0.05)	>0.05
MCA PI/UA PI ratio	1.91 (0.38)	1.56 (0.25)	**>0.05**
MCA RI/UA RI ratio	1.29 (0.12)	1.02 (0.14)	**<0.0001§**
UA: umbilical artery.	MCA: middle cerebral artery.	UtA: uterine artery	
PI : pulsitility index	RI : resistance index	CPR : cerebroplacental ratio	

There was no statistically significant difference could be detected between both groups as regard mode of delivery, baby's gender, birth weight and adverse maternal outcomes, but there was statistically significant difference as regard Apgar score at 1 min and Apgar score at 5 min (Table 10).

Table (10): Mode and outcome of delivery in patients with or without adverse neonatal outcomes.

Groups / Parameters	No adverse neonatal outcomes	Adverse neonatal Outcomes	*p-value*
	NO. (%)		
Mode of delivery			0.781¶
SVD	9 (26.5%)	5 (31.3%)	
AVD	8 (23.5%)	2(12.5%)	
CS	17(50.0%)	9(56.3%)	
Baby's gender			1.000#
Male	20(58.8%)	10 (62.5%)	
Female	14(41.2%)	6(37.5%)	
Adverse maternal	11(32.4%)	5(31.3%)	0.938#
Outcomes			
	Median (interquartile range)		
Apgar score at 1 min.	7 (6 – 8)	5 (4 – 6)	**<0.0001§**
Apgar score at 5 min.	10 (10 – 10)	7 (6 – 8)	**<0.0001§**
	mean (SD)		
Birth weight, gm.	3725 (285)	3698 (234)	0.741¥
SVD: Spontaneous vaginal delivery.		CS: caesarean section	
AVD: Assisted vaginal delivery with induction.			

Middle cerebral artery (MCA) PI had a fair predictive value as evidenced by an area under the ROC curve (AUC) of 0.72 (95% CI, 0.58 - 0.86; p-value, 0.003). The best cut-off criterion was an MCA PI of ≤1.31 (J index, 0.44). This had a sensitivity of 93.8% (95% CI, 69.8% - 99.8%), specificity of 50.0% (95% CI, 32.4% - 67.6%); a positive predictive value (PPV) of 46.9% (95% CI, 29.1% - 65.3%), and a negative predictive value of 94.4% (95% CI, 72.7% - 99.9%) (Table 11).

Umbilical artery (UA) PI was non-predictive of adverse neonatal outcomes as evidenced by an area under the ROC curve (AUC) of 0.52 (95% CI, 0.42 - 0.76) that was not statistically significant from random prediction (p-value, 0.312). The best cut-off criterion was an UA PI of >0.7 (J index, 0.18). This had a sensitivity of 56.3% (95% CI, 29.9% - 80.2%),

specificity of 61.8% (95% CI, 43.6% - 77.8%); a positive predictive value (PPV) of 40.9% (95% CI, 20.7% - 63.63%), and a negative predictive value of 75.0% (95% CI, 55.1% - 89.3%) (Table 11).

Uterine artery (UtA) PI was non-predictive of adverse neonatal outcomes as evidenced by an area under the ROC curve (AUC) of 0.58 (95% CI, 0.41 - 0.75) that was not statistically significant from random prediction (p-value, 0.368). The best cut-off criterion was an UtA PI of >0.75 (J index, 0.21). This had a sensitivity of 62.5% (95% CI, 35.4% - 84.8%), specificity of 58.8% (95% CI, 40.7% - 75.4%); a positive predictive value (PPV) of 41.7% (95% CI, 22.1% - 63.4%), and a negative predictive value of 76.9% (95% CI, 56.4% - 91.0%) (Table 11).

Table (11): Receiver-operating characteristic (ROC) curve analysis for the value of various Doppler indices for prediction of adverse neonatal outcomes**.**

Predictor / ***ROC index***	**MC A PI**	**MC A RI**	**UA PI**	**UA RI**	**UtA PI**	**UtA RI**	**MCA/U A PI**	**MCA/U A RI**
AUC	0.72	0.75	0.59	0.86	0.58	0.61	0.78	0.92
95% CI for	0.58 -	0.59 -	0.42 -	0.73 -	0.41 -	0.43 -	0.64 -	0.82 -
AUC	0.86	0.92	0.76	0.99	0.75	0.78	0.91	1.00
p-value¶	**0.003**	**0.002**	0.312	**<0.0001**	0.368	0.230	**<0.0001**	**<0.0001**
J index	0.44	0.51	0.18	0.69	0.21	0.22	0.50	0.78
Cut-off criterion	≤1.31	≤0.66	>0.7	>0.64	>0.75	>0.46	≤1.90	≤1.1
Sensitivity	93.8	62.5	56.3	75.0	62.5	75.0	93.8	81.3
95% CI for	69.8 -	35.4 -	29.9 -	47.6 -	35.4 -	47.6 -	69.8 -	54.4 -
Sensitivity	99.8	84.8	80.2	92.7	84.8	92.7	99.8	96.0
Specificity	50.0	88.2	61.8	94.1	58.8	47.1	55.9	97.1
95% CI for	32.4 -	72.5 -	43.6 -	80.3 -	40.7 -	29.8 -	37.9 -	84.7 -
Specificity	67.6	96.7	77.8	99.3	75.4	64.9	72.8	99.9
PPV	46.9	71.4	40.9	85.7	41.7	40.0	50.0	92.9
95% CI for	29.1 -	41.9 -	20.7 -	57.2 -	22.1 -	22.7 -	31.3 -	66.1 -
PPV	65.3	91.6	63.6	98.2	63.4	59.4	68.7	99.8
NPV	94.4	83.3	75.0	88.9	76.9	80.0	95.0	91.7
95% CI for	72.7 -	67.2 -	55.1 -	73.9 -	56.4 -	56.3 -	75.1 -	77.5 -
NPV	99.9	93.6	89.3	96.9	91.0	94.3	99.9	98.2

AUC: area under the ROC curve. PPV: positive predictive value. ¶DeLong method NPV: negative predictive value. UA: umbilical artery. MCA: middle cerebral artery.
UtA: uterine artery PI : pulsitility index RI : resistance index

The differences between the following pairs of AUCs were statistically significant:

- MCA PI vs. MCA/UA RI ratio (p-value, 0.009).
- MCA RI vs. MCA/UA RI (p-value, 0.042).
- UA PI vs. UA RI (p-value, 0.007).
- UA PI vs. MCA/UA RI (p-value, 0.001).
- MCA/UA PI vs. MCA/UA RI (p-value, 0.036).
- UA RI vs. UtA PI (p-value, 0.002).
- UA RI vs. UtA RI (p-value, 0.013).
- MCA/UA RI vs. UtA PI (p-value, <0.001)
- MCA/UA RI vs. UtA RI (p-value, 0.001).

Cases with Apgar score at 5 min <7 had lower amniotic fluid index when compared to cases with Apgar score at 5 min ≥7 and the relation was statistically significant, but about mode of delivery, parity and other variables there was no statistically significant difference in between by using P-value (P > 0.05). (Table 12).

Table (12): Comparison of the receiver-operating characteristic (ROC) curves for prediction of adverse neonatal outcomes using various Doppler indices **.**

Comparison	ΔAUC	95% CI of ΔAUC	p-value¶
MCA PI vs. MCA RI	0.03	-0.16 to 0.23	0.715
MCA PI vs. UA PI	0.13	-0.12 to 0.38	0.319
MCA PI vs. UA RI	0.14	-0.04 to 0.32	0.133
MCA PI vs. MCA/UA PI	0.06	-0.02 to 0.14	0.128
MCA PI vs. MCA/UA_RI	0.20	0.05 to 0.35	**0.009**
MCA RI vs. UA PI	0.16	-0.11 to 0.43	0.234
MCA RI vs. UA RI	0.11	-0.13 to 0.34	0.381
MCA RI vs. MCA/UA PI	0.03	-0.18 to 0.22	0.825
MCA RI vs. MCA/UA RI	0.17	0.01 to 0.32	**0.042**
UA PI vs. UA RI	0.27	0.07 to 0.462	**0.007**
UA PI vs. MCA/UA PI	0.19	-0.01 to 0.38	0.063
UA PI vs. MCA/UA RI	0.33	0.14 to 0.52	**0.001**
UA RI vs. MCA/UA PI	0.08	-0.07 to 0.24	0.303
UA RI vs. MCA/UA RI	0.06	-0.04 to 0.16	0.258
MCA/UA PI vs.MCA/UA RI	0.14	0.01 to 0.27	**0.036**
MCA PI vs. UtA PI	0.14	-0.08 to 0.36	0.216
MCA PI vs. UtA RI	0.11	-0.11 to 0.34	0.332
MCA RI vs. UtA PI	0.17	-0.04 to 0.39	0.113
MCA RI vs. UtA RI	0.14	-0.11 to 0.40	0.253
UA PI vs. UtA PI	0.01	-0.23 to 0.25	0.929
UA PI vs. UtA RI	0.02	-0.12 to 0.23	0.880
UA RI vs. UtA PI	0.28	0.11 to 0.45	**0.002**
UA RI vs. UtA RI	0.25	0.05 to 0.45	**0.013**
UtA PI vs. UtA RI	0.03	-0.21 to 0.26	0.819
MCA/UA PI vs. UtA PI	0.20	-0.01 to 0.40	0.058
MCA/UA PI vs. UtA RI	0.17	-0.04 to 0.38	0.106
MCA/UA RI vs. UtA PI	0.34	0.17 to 0.50	**<0.001**
MCA/UA RI vs. UtA RI	0.31	0.12 to 0.50	**0.001**

AUC: area under the ROC curve. ΔAUC: difference between AUCs. 95% CI: 95% confidence interval.
¶DeLong method. UA: umbilical artery. MCA: middle cerebral artery. UtA : uterine artery
PI: pulsitility index RI : resistance index

Cases with Apgar score at 5 min<7 had lower CPR, MCA RI and MCA/UA RI ratio and higher UA RI compared to cases with Apgar score at 5 min ≥7 with statistically significant difference in between by using P value p<0.05. On the other hand there is no statistically significant difference between both groups as regard other markers.(Table 13).

Table(13): Relation between various Doppler indices and the occurrence of an Apgar score at 5 min of <7.

Apgar score / ***Parameters***	***5 min ≥7 (n=44) mean (SD)***	***5 min <7 (n=6) mean (SD)***	***p-value***
Middle cerebral artery PI	1.30 (0.26)	1.08 (0.11)	0.056¶
Middle cerebral artery RI	0.73 (0.06)	0.66 (0.06)	**0.022¶**
Umbilical artery PI	0.70 (0.06)	0.77 (0.14)	0.283¶
Umbilical artery RI	0.59 (0.06)	0.72 (0.08)	**<0.0001¶**
Uterine artery PI	0.74 (0.09)	0.78 (0.08)	0.303¶
Uterine artery RI	0.48 (0.06)	0.49 (0.04)	0.689¶
MCA/UA PI ratio (CPR)	1.84 (0.37)	1.43 (0.24)	**0.010¶**
MCA/UA RI ratio	1.24 (0.15)	0.92 (0.05)	**<0.0001§**

PI: Pulsitility index. RI: Resistance index. UA: Umbilical artery. MCA: Middle cerebral artery. ¶Unpaired t test. §Welch test.

DISCUSSION

In this cross sectional study we evaluated the impact of prolonged pregnancy ≥ 287 days on MCA, UA, UtA Doppler indices in 50 women.

By distribution of the studied cases as regard general data, there was no statistical signification with maternal age and gestational age among the study cases but for the parity, primigravida had the highest rate (44%). So, post-term pregnancy was common with primigravida more than in multipara in the studied cases agreeing with study by ***Crowley (2005)*** who found that prolonged pregnancy increased in first pregnancy.

By analysis of the delivery data of the studied cases, the incidence of cesarean delivery was more than spontaneous vaginal delivery or assisted delivery due to prolonged labor more than expected time or fetal distress or failed induction due to unfavorable cervix or failure to progress So, the rate of cesarean section (C.S.) in the study had the highest rate (52%) of studied cases. These results agreed with study by ***Tasic et al. (2007)*** who found male fetus gender significantly predisposes to the prolongation of pregnancy.

The present study showed that average fetal weight was 3738 g. with about 5 cases had neonatal macrosomia. This was

in agreement with most of the studies that found the incidence of neonatal macrosomia (delivery weight over 4000 g.) was higher in post-term pregnancy ***Divon (2002)***.

Uncomplicated prolonged pregnancy, even though placental senescence limits nutrient transfer. This bottle neck is overridden by enhanced placental flow indeed. It would explain the observation that macrosomia is a common feature of prolonged pregnancy.This result agreed with study by ***Tasic et al. (2007)*** who found the incidence of neonatal macrosomia was 17 % of cases in post-date cases ***Lam et al. (2005a).***

Similarly reported that large - for - gestational age (LGA) particularly infants with a birth weight greater than 4 kg, is one of the important problems encountered in post-date pregnancy, with an incidence of 25.5 % at 41 week vs. 4% for those delivered between 38 and 40 week.

In the present study, Apgar score at 1 min. was not specific alone to evaluate the neonates, but Apgar score at 5 min. was more specific as Apgar score was improved by neonatal resuscitation. There was 32% with adverse neonatal outcome in which the most complication was meconium aspiration leading to respiratory distress followed by incubation of neonates.These results agreed with study done by ***Lam et al. (2005b)*** who found meconium stained liquid, and meconium aspiration syndrome (MAS) increased with post-term pregnancy.

In the current study, there were neither structural abnormalities nor intrauterine fetal death encountered in this study, but only one baby died after two days of delivery. That the absence of fetal death could be due to the use of the recent methods of monitoring postdating fetuses. That the most complication to the mother was prolonged labor more than expected time for each stage of labor that also raised the rate of cesarean delivery for fetal distress.

According to neonatal outcome, the study cases were a group without adverse neonatal outcome and a group with adverse neonatal outcome. There was no statistical significant difference between both groups as regard maternal age, parity and gestational age. Fetal weight and fetal heart rate showed no statistical significant difference between both groups, but group with adverse neonatal outcome had lower amniotic fluid index compared to other group with statistically significant difference between them, So there was are association between oligohydramnios and increased risk of adverse neonatal outcome like meconium aspiration syndrome. These results agreed with study done by ***Hovi et al. (2006)*** who found that post-term infants experienced meconium passage (21.2% versus 12.8%). Similarly, ***Lam et al. (2006)*** reported that although overall AFI correlated with thick MSL and the need for intervention for fetal distress, its sensitivity and specificity are limited, in postdate pregnancies.

By comparison of Doppler indices between both groups, we found that UA PI had minimal higher mean value in the group with adverse outcome compared to the group without adverse outcome with no statistically significant difference between both groups. These results agreed with ***Usha et al. (2006)***. who discovered absence of any statistical significant

difference in the umbilical artery Doppler, or middle cerebral artery (PI) in predicting adverse perinatal outcome. Against this study the study, done by ***Olofsson et al. (1997)***. found that in post-term pregnancies, subclinical fetal hypoxia may trigger vasodilation of placental vessels (with consequent decrease in umbilical artery PI) ,and indicates an increase of cardiac output with consequent increased aortic volume flow.

Our study showed that the group with adverse outcome had higher UA RI than the group without adverse neonatal outcome with statistically significant difference between both of them. Also, UA RI had a good predictive value as evidenced by an area under the ROC curve (AUC) of 0.86.This result agreed with study done by ***Olofsson et al. (1997)*** who found that patients with fetal distress had higher umbilical artery RI values and lower middle cerebral artery RI values. The reason behind all these parameters is the presence of a probable chronic hypoxia. Also, ***Ozerena et al. (1999)*** found that UA RI had diagnostic accuracy and sensitivity which is also better than that of MCA RI.

Similarly, ***Hershkovitz et al. (2000), Sterne et al. (2001) and Vergani et al. (2005)*** support these results regarding CPR being better predictor of fetal compromise than neither MCA PI nor UA PI alone.

In their study on MCA PI, UA PI and CPR ratio in post-dated pregnancies, concluded that Doppler information may play a role in differentiating post-dated pregnancies, which may be followed by expectant management from those in whom induction is a better option. However, low positive predictive value of CPR ratio can result in missing cases with fetal jeopardy and high false positive rate can result in undue concern, expensive testes and unnecessary interference.

In the present study, ratio of MCA RI /UA RI was higher in the group without adverse neonatal outcome than the group with adverse neonatal outcome with highly statistically significant difference between them, and according to the area under the ROC curve (AUC) which was 0.92, MCA RI/UA RI ratio had an excellent predictive value for adverse neonatal outcome.

MCA RI /UA RI ratio had the highest specificity (97.1 %) with best cut-off point ≤1.1 and diagnostic accuracy in predicting perinatal outcome.These results agreed with the study done by ***Elebrashy and Edris (2006)***, and also agree with the study of ***Devine et al. (1994)*** who. reported that decreased fetal middle cerebral artery to umbilical artery impedance to flow ratio is an accurate method of predicting post-date-related adverse outcome.

In the present study ,we noticed that the uterine indices (UtA PI & UtA RI) did not change in both groups (adverse and no adverse), and had no statistically significant difference between them. So, it was not significant in prediction of neonatal outcome. These results agreed with ***Farmakides et al. (1988)*** who reported that impedance to flow in the uterine and umbilical arteries was not altered even in the presence of other signs suggestive of fetal compromise.

Some studies provided that uterine indices is more significant and provide a more accurate prediction when performed in the second trimester than in the first

trimester. An increased pulsitility index with notching was the best predictor of pre-eclampsia. It was also the best predictor of overall and severe intrauterine growth restriction among low-risk patients ***(Coomarasamy et al., 2001 and Askie et al., 2007).***

The Doppler indices may be normal but there was adverse perinatal outcome. These results agreed with ***Tasic et al. (2007)*** who noticed that normal values of Doppler velocity indices in uteroplacental circulation confirm the assumption that in pregnancy after 40th gestation week, problems arise not from the uteroplacental unit, but rather from changes in fetoplacental circulation, normal values of Doppler indices in uterine arteries, umbilical and medial cerebral artery of fetus are found with unsatisfactory perinatal outcome. According to their results, findings in those studies suggest that unsatisfactory perinatal outcome is possible in post-date pregnancy even if there is no placental insufficiency. This finding also shows that bad perinatal outcome is under the influence of some other variables that are not connected with prolonged pregnancy.

Similarly, ***Stokes (2008)*** found that umbilical artery Doppler flow velocity waveform from pregnancies associated with fetal compromise and abnormal neonatal outcome were similar to those from pregnancies in which the outcome was normal. Doppler flow velocity waveform analysis is unlikely to be of benefit in the routine assessment of postdate pregnancy.

Also***, Usha et al. (2006)*** discovered absence of any statistical significant difference in the umbilical artery Doppler or middle cerebral artery (PI) in predicting adverse perinatal outcome. They attributed this to that, in uncomplicated post-date pregnancies, the mechanism of fetal compromise is perhaps due to decrease in the flow of nutrients across the placenta, and decrease in the efficiency of utilization of nutrients by the placenta and the fetus.

In the present study, there was no statistically significant difference between adverse neonatal outcome group and the group without adverse neonatal outcome as regard fetal gender (males and females), birth weight, adverse maternal outcome and mode of delivery, but there was astatistically significant difference between both groups as regard Apgar score at one and five minutes. MCA RI /UA RI ratio had the highest specificity (97.1), and the highest PPV (92.9). It was the best predictor in comparison with other parameters for prediction of neonatal outcome with best cut-off $\leq$1.1 followed by UA RI with specificity (94.1%) and sensitivity (75%). On the other hand,

MCA PI/ UA PI ratio (CPR) had the highest sensitivity (93.8%) and the highest NPV (95%).

Thus, the net result in the present study showed that MCA RI/UA RI ratio had the highest possible predictivity and specificity in prediction of neonatal outcome but combination of all parameters improved both sensitivity and predictivity.

CONCLUSION

The perinatal morbidity and mortality may be increased in post-term pregnancies. However, the all screening tests and

Doppler indices may be normal due to mode of delivery, time of delivery and type of anesthesia during labor. So ,during labor a rapid interference should be taken to decrease incidence of adverse neonatal outcome.

In post-term pregnancies with adverse outcomes, impedance to flow in the umbilical arteries may be increased, while impedance to flow in the fetal middle cerebral arteries may be decreased, but impedance to flow in the uterine arteries may be normal.

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دراسة معلمات الدوبلر للشريان الدماغى الأوسط للأجنة والشريان السرى/ والشريان الرحمي في التنبوء بالحمل لفترات طويلة وتأثيرها على حديثي الولادة

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خلفية البحث: يتأثر عمر الحمل بالعديد من العوامل مثل عمر الأم، الحمل المتكرر، تدخين الأم، ونوع الجنين أو الوزن عند الولادة , والتاريخ الماضي. بالإضافة إلى ذلك ابحاث دقة الدراسات السابقة محدودة بسبب حقيقة أنها تسبق الإستخدام على نطاق واسع في كل من الموجات فوق الصوتية للدقة التي يرجع تاريخها الحمل وإختبار الجنين مكثفة لإقامة رفاهية الجنين

الهدف من البحث: تحديد قيمة مؤشرات دوبلر للشريان الدماغي الأوسط للجنين و السري والشريان الرحمي/ وتقييم بواسطة الموجات فوق الصوتية في الحمل في أو خارج 40 أسبوعا من الحمل، وربط ذلك مع نتائج الفترة المحيطة بالولادة.

المرضى وطرق البحث: تضمنت الدراسة 50 من السيدات الحوامل ، وقدمت جميع المرضى للموجات فوق الصوتية للكشف عن جنس الجنين، ووزن الجنين ، ومؤشر السائل الأمنيوسي، أيضا ، قدمت سرعة الدوبلر لمشيمة الجنين والجنين بما في ذلك مؤشر نبض الشريان الأوسط الدماغي،و مؤشر نبض الشريان السري، و مؤشر المقاومة الدماغي الأوسط،،و الشريان السري مؤشر المقاومة،و مؤشر النبض الشريان الرحمي، ومؤشر النبض للشريان الرحمى.

النتائج: لم يكن هناك دلالة إحصائية مع عمر الحمل، ومعدل قلب الجنين وتعدد الحمل وكان الحمل البكرى أعلى نسبة، وكان هناك نسبة أعلى من القيصرية الذي كان كبيرا مع إطالة فترة الحمل، ولكن مع عدم وجود فروق ذات دلالة إحصائية بين نتائج سلبية وطبيعية أيضا،و كانت نسبة الذكور أكثر من الإناث في عدد السكان لدينا لا علاقة ذات دلالة إحصائية مع نوع الجنين وكانت نتائج حديثي الولادة مرتبطة مع إنخفاض معدل سرعة ومعدل مقاومة الشريان الأوسط الدماغي، ونتيجة ابجر، وأعلى معدل مقاومة الشريان السري مع فروق ذات دلالة إحصائية ، ولكن لم يكن هناك فروق ذات دلالة إحصائية مع معدل سرعة الشريان السري،ومعدل سرعة ومقاومة الشريان الرحمي

الاستنتاج: معدلات الإعتلال والوفيات حول الولادة قد تكون الزيادة في مرحلة ما بعد ميعاد الولادة، وجميع فحوص العامة ومؤشرات الدوبلر قد تكون طبيعية بسبب طريقة الولادة، ووقت الولادة، ونوع التخدير خلال أثناء المخاض. وينبغي أن يؤخذ التدخل لتقليل حدوث لحديثي الولادة مضاعفات سلبية بعد ميعاد الولادة، عند حدوث مقاومة لتدفق زيادة الشرايين السري، وبينما مقاومة التدفق للشرايين الدماغية المتوسطة للجنين قد تنخفض، ولكن مقاومة التدفق قد تكون شرايين الرحم الطبيعي.