Med. J. Cairo Univ., Vol. 62, No.1 March (Suppl.): 45-51, 1994

Study of Umbilical and Uterine Arteries Doppler Velocimetry, Biophysical Profile, Placental Grading and Maternal Plasma Fibronectin Level in Pre-Eclampsia

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Abstract

The present study was conducted on 30 pre-eclamptic patients and 20 well matched normotensive pregnant women. All studied cases were subjected to the study of umbilical and uterine arteries Doppler velocimetry, biophysical profile, placental grading, and maternal plasma fibronectin estimation. All these studied parameters with exception of placental grading, showed abnormal findings in pre-eclampsia. The umbilical artery Doppler velocimetry, fetal biophysical profile and maternal plasma fibronectin levels were significantly correlated with the severity of pre-eclampsia. The correlation between the different studied parameters and fetal outcome using Apgar scoring has been evaluated where fetal biophysical scoring proved to have the best accuracy. No significant results could be detected between the studied groups concerning placental grading and uterine artery velocimetry.

Introduction

PRE-ECLAMPSIA is a complication of pregnancy which is considered to be both common and potentially dangerous for the mother and the foetus [1]. Doppler studies may be performed to assess the foetal umbilical and the maternal uterine circulations. As pre-eclampsia is associated with abnormality in umbilical and uterine arteries, Doppler study have been expected to be of value in the management of pre-eclampsia [2].

Fibronectin is intimately associated with the vascular endothelium, and its measurement in maternal plasma may serve as indicator of endothelial damage in pre-eclampsia [3].

Fetal biophysical scoring has gained

acceptance as a method of antepartum fetal risk assessment. It appears to offer the advantage of grading various degrees of fetal compromise [4].

The present work is planned to evaluate four different parameters in pre-eclampsia (umbilical and uterine arteries Doppler studies, biophysical profile, placental grading, and maternal plasma fibronectin level), in order to display their role in the determination of the time of intervention and thus improvement of fetal outcome.

Material and Methods

All cases were selected from those admitted to the obstetric Department of Kasr El Aini Hospital. The study included fifty pregnant women divided into two groups :

I. *Control group :*

It includes 20 healthy normal pregnant women in the third trimester. Their selection was based on the criteria of normal pregnancy according to Thornton and Bonnar [5].

II. *Pre-eclamptic group :*

It includes 30 pre-eclamptic women in the third trimester. The criteria of pre-eclampsia were based according to the American College of Obstetricians and Gynecologists [6]. Patients in this group were subdivided into two subgroups according to severity of pre-eclampsia :

IIa. The diastolic blood pressure was 90 mmHg or above but below 110 mmHg, proteinurea either trace or 1 + (n = 12).

IIb. The diastolic blood pressure was 110 mmHg or more, persistant proteinuria of 2 + or more. (n = 18).

All subjects of the study were subjected to the following:

1. History and clinical examination.

2. Ultrasonographic study for assessment of :

a) Biometric measurements to assess gestational age and foetal growth through determination of biparietal diameter, head circumference, abdominal circumference and femur length. The study also included the estimation of fetal weight, using Hadlock equation [7].

b) Umbilical and uterine arteries Doppler waveform analysis.

c) Biophysical profile.

d) Placental echography [8].

3. Maternal blood sample for estimation of plasma fibronectin level.

4. Study of foetal outcome by estimation of birth weight and Apgar score at one and five minutes.

These measures were carried out prior to termination of pregnancy by a period ranging from 1-10 days.

Results

The results of the present work are presented in the following tables. Both the control group and the pre-eclamptic group

The gestational age for the control group ranged from 36-40 weeks with a mean of 38.3 ± 1.31 weeks. While, for the pre-eclamptic group it ranged from 36 - 40 weeks with a mean of 37.9 ± 1.3 weeks. and for the severe pre-eclampsia ranged from 34 - 40 weeks with a mean of 36.94 ± 1.79 weeks.

Table (1) : Statistical Comparison between Control Group and each of all Preeclamptic Group, Mild and Severe Preeclamptic Subgroups as Regards Umbilical Artery Doppler Velocimetry.

Parameter	Control	All preeclamptic	Mild preelamptic	Severe preeclamptic
Umbilical artery resisance index				
Mean ±S.D.	0.51+0.067	0.69+0.08	0.64+0.05	0.72±0.82
t		5.6	5.52	8.8
p		<0.001	<0.001	<0.0001
Corrected umbilical artery A/B ratio				
Mean ± S.D.	2.09+0.3	3.66±0.9	3.02+0.4	4.11±0.9
t		5.8	5.6	8.2
p		<0.001	<0.001	<0.0001

Table (2):Statistical Comparison between Control Group and each of all Preeclamptic Group, Mild and Severe Preeclamptic Subgroups as Regards Uterine Artery Doppler Velocimetry.

Parameter	Control	All preeclamptic	Mild preelamptic	Severe preeclamptic
Uterine artery resisance index				
Mean ±S.D.	0.49+0.05	0.55+0.1	0.56+0.13	0.55±0.12
t		1.8	2.19	1.9
p		<0.05	<0.001	<0.05
Uterine artery A/B ratio				
Mean ±S.D.	2.0+0.2	1.96±1.1	2.49+0.8	2.01±0.14
t		2.04	3.1	2.19
p		<0.01	<0.001	<0.01

Table (3):Statistical Comparison between the Control Group and each of all Preeclamptic Group, Mild and Severe Preeclamptic Sub-groups asRegards Biophysical Profile.

Biophysical profile	Control	All pre-eclampsia	Mild per-eclampsia	Severe pre-rclampsia
Range	6-8	2-8	6-8	2-8
Mean ± S.D	7.5±0.8	6.6±1.9	7.6±0.7	5.8±2.1
t		2.1	0.52	3.12
p		<0.01	>0.05	<0.001

Table (4):Statistical Comparison between Control Group and each of all Preeclamptic Group, Mild and Severe Preeclamptic Subgroups as Regard Fibronectin Level.

	Control	All preeclamptic	Mild pereeclamptic	Severe preeclampsia
No. of cases	20	30	12	18
Range	65-280	200-575	200-515	210-575
Mean ± S.D.	177.25±50.95	392.3±143.5	326.25±127.45	436.39-139.65
t	5.8	5.8	4.68	7.7
p	<0.01	<0.01	<0.01	<0.001

Table (5):Statistical Comparison between the Control Group, and each of all Preeclamptic Groups. Mild and Severe Preeclamptic Sub-groups as Regards Placental Grading .

Placental grading	Control	All preeclamptic	Mild pereeclamptic	Severe preeclampsia
Range	2-3	2-3	2-3	2-3
Mean ± S.D.	2.5±0.5	2.6±0.5	2.75±0.4	2.4±0.5
t		1.32	1.41	0.33
p		>0.05	>0.05	>0.05

Table (6): Evalution Different Parameters in Relation to Apgar 1 min.

Test	Biophysical profile	Fibronectin	Umbilical artery A/B ratio
Sensitivity	82%	54%	70%
Specificity	92%	67%	78%
Positive predictive value	88%	80%	84%
Negative predictive value	86.6%	78%	83%
Likelihood ratio			
of positive test	66%	58%	64%
of negative test	60%	56%	28%
Accuracy	85%	56%	79%

Table (7): Evalution Different Parameters in Relation to Apgar 5" min.

Test	Biophysical profile	Fibronectin	Umbilical artery A/B ratio
Sensitivity	80%	66%	78%
Specificity	96%	80%	90%
Positive predictive value	90%	60%	91%
Negative predictive value	86.6%	62%	75%
Likelihood ratio			
of positive test	65.5%	64%	76.4%
of negative test	62%	52%	61%
Accuracy	78%	66.6%	76%

Discussion

Pre-eclampsia continues to be responsible for a large number of maternal deaths [9]. Moreover, pre-eclampsia may lead to fetal and neonatal morbidity and mortality [10]. In the present study, four different parameters, namely, Doppler study of both umbilical and uterine arteries, biophysical profile, placental grading, and maternal plasma fibronectin level, were assessed and statistically evaluated so as to elucidate their role in management of pre-eclampsia and determination of the time of intervention.

In the present study, the umbilical artery resistance index and corrected A/B ratio were significantly higher in all pre-eclamptic patients compared to the control group ($p < 0.001$). They were also higher in the group of severe pre-eclampsia if compared to the group of mild pre-eclampsia. These results were in agreement with the work of Trudinger and Cook [11].

In this study, placental grading did not significantly differ in all pre-eclamptic patients if compared to the control group ($p > 0.05$). Similarly, there was no significant difference between the mild and severe cases of pre-eclamptic cases.

The maternal plasma fibronectin level was significantly higher in all pre-eclamptic patients if compared to the control group ($p < 0.01$). Morever, the fibronectin level was significantly higher in the group of severe pre-eclampsia if compared to mild cases ($p < 0.01$). Hence, the plasma fibronectin level was found to be increased in pre-eclampsia, and correlated to its severit . This finding was in agreement with many investigators as Charles et al and Samuels et al [12, 13].

For prediction of Apgar score at 1 and 5 minutes, the fetal biophysical profile had the best accuracy (85%, 78%.) followed by corrected umbilical A/B ratio, while the maternal fibronectin level had the lowest accuracy (56%, 66.6%). Non stress test when performed following an abnormal biophysical profile (modified Manning score [14], improved the identification of the actually endangered foetus.

The findings of the present work failed to demonstrate a significant relation between uterine artery Doppler study and severity of pre-eclampsia or fetal outcome.

Nevertheless, the combination of fetal biophysical profile and corrected umbilical A/B ratio may be needed to improve prediction of both Apgar score and detection of fetal demise. So, these two tests should be considered in the evaluation of pre-eclamptic patients and in the determination of the time of interference.

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