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Research Article

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Prognostic Value of Doppler Ultrasound in Pre-eclampsia at Tripoli University Hospital (2007-2009)

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ABSTRACT

Doppler ultrasound provides a non-invasive method for the study of fetal hemodynamic. Investigation of the uterine and umbilical arteries gives information on the perfusion of the uteroplacental and fetoplacental circulations. The study aimed to investigate the prognostic value of Doppler ultra sound in assessment of fetal wellbeing in pre-eclamptic pregnant women, and to study the correlation between pulsatility index of umbilical artery, middle cerebral artery, and perinatal outcome in pregnancy with pre-eclampsia. This was a prospective observational study; conducted in Obstetrics and Gynecology Department at Tripoli University Hospital, which includes pregnant women with pre-eclampsia with or without intrauterine growth restriction (IUGR) from January 2007 to December 2009. Variables include umbilical and middle cerebral artery pulsatile index (for fetal outcome), uric acid level, a gestational age at delivery, time interval between last Doppler examination and delivery, Apgar score, and birth weight. A total of 402 patients completed the study, the age ranged from 20-45 years old. The perinatal mortality rate was 6.5%, increased with increase serum uric acid level, and most of babies were preterm (32-34 weeks of gestation) with high perinatal death. The majority of umbilical artery pulsatile index (UMAPI) within normal centile (5^{th}- 95^{th}) with perinatal death of 6%; while the perinatal death of 7.2% were associated with abnormal UMAPI centile, inabnormal middle cerebral artery pulsatile index (MCAPI) centile (<5th) with the perinatal death were 52.2%, among normal MCAPI centile (5^{th} ->95^{th}) the perinatal death was 3.7%. The perinatal death increased with birth weight centile <5^{th} centile to 20%, and babies low Apgar score at 5 minutes of delivery with high perinatal death of 68.4%. This study indicates that the Doppler ultrasound is a noninvasive method for study of fetal hemodynamics to give information on the perfusion of the fetoplacental circulation. MCAPI is more sensitive for the perinatal outcome.

Keywords- *Doppler ultrasound; Pregnancy; Pre-eclampsia.*

INTRODUCTION

Doppler ultrasound provides a non-invasive method for the study of fetal hemodynamic investigation of the uterine and umbilical arteries, gives information on the perfusion of the uteroplacental and fetoplacental circulations.[1] Pre-eclampsia (P.E) and intrauterine growth restriction (IUGR) are associated with an inadequate quality and quantity of the maternal vascular response to placentation, in both conditions, there are characteristic pathological findings in the placental bed.[2]

Reduced umbilical venous flow volume or increased placental blood flow resistance are the earliest signs of reduced villous perfusion. Absent or even reversal of umbilical artery end diastolic velocity indicates that 60-70% of placental villous vasculature has been damaged with the risk of fetal hypoxemia and potentially acidemia. The late Doppler changes are indicative of advancing circulatory decompensation and potentially impending fetal demise. The pulsatility index of umbilical artery offers a valuable monitoring measurement even in the absence or reversal of end diastolic velocity.[3]

The middle cerebral artery (MCA) to umbilical artery (UMA) ratio provides a quick assessment of blood flow without nomograms, the resistance of the cerebral circulation should always be higher than the umbilical resistance (ratio >1). Ratios less than 1 signify brain sparing.[4]

A high correlation with the outcome parameters was found. In the presence of normal flow velocity waves (FVWs), it is sufficient to measure only two arteries, one peripheral and one central. However, the measurement of two additional arteries is of advantage in the event of pathological findings.[5] The umbilical artery represents the fetoplacental system, and primarily reflects placental resistance.[6] Growth-retarded fetus with absent or reverse end-diastolic flow in the umbilical artery not only have an increased fetal and neonatal mortality but also a higher incidence of long-term permanent

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neurologic damage when compared with growth-retarded fetuses with diastolic flow in the umbilical circulation.[7] In clinical practice, abnormal end-diastolic umbilical venous pulsation` seems to be a late and ominous sign of a severely compromised fetus. The umbilical artery Doppler indices are usually obtained serially when a fetus is deemed to be at increased perinatal risk.[8]

The current study conducted to study the prognostic value of Doppler ultrasound in assessment of fetal wellbeing in pre-eclamptic patients and to study the correlation between umbilical artery, middle cerebral artery pulsatility index and perinatal outcome in patients with pre-eclampsia.

MATERIALS AND METHODS

This was a prospective observational study conducted in Obstetrics and Gynecology Department at University Hospital, Tripoli, Libya; which includes pregnant women with pre-eclampsia with or without IUGR, from January 2007 to December 2009. Inclusion criteria including viable singleton pregnancy, the gestational age was between 32-38 weeks complicated with pre-eclampsia. Pre-eclampsiawas diagnosed according the criteria of the International Society for the study of hypertension in pregnancy. A previous normotensive woman after the 20th week with: diastolic BP ≥ 90 mm Hg measured twice or more ≥ 4 hours apart or diastolic BP ≥110 mmHg on any one occasion of pregnancy with proteinuria of ≥ 300 mg/L in 24-hour urine or two clean-catch-midstream or catheter specimens of urine collected ≥4 hours apart with ≥2+ on reagent strip. Variables include umbilical and middle cerebral artery pulsatile index (for fetal outcome), uric acid level, a gestational age at delivery, time interval between last Doppler examination and delivery, Apgar score, and birth weight. Umbilical artery velocimetry study was performed at least once a week by means of pulsed Doppler equipment with a 3.5 MHz transducer. Only the results of the last Doppler which was performed within 3 days of delivery were considered in the correlation with perinatal outcomes. An abnormal Doppler velocimetry was defined as pulsatility index being higher than 95th percentile for gestational age, or absent or reversed end diastolic velocity waveforms in umbilical artery, and the pulsatility index in the fetal middle cerebral artery is less than 5th percentile for gestational age, each vessel was measured twice. The difference between the values was always below 6%. The first value was used in most cases, the umbilical artery was examined in any favorable position, the angle between the Doppler beam and the selected vessel was always kept below 60°. The woman was placed in a semi-recumbent position and the transducer was moved to the base of the fetal head, in order to obtain the MCA waveform. Using color flow imaging, the MCA could be seen as a major lateral branch in the circle of Willis, running antero-laterally towards the lateral edge of the orbit. The pulse Doppler sample gate was placed on the proximal portion of this vessel to obtain flow velocity waveforms, Umbilical Artery Doppler waveforms were obtained from the fetal end of the cord, as they are significantly higher than those at the placental end. The convex transducer was applied to the maternal abdomen with minimal pressure, in order to avoid the effect of fetal head on the cerebral flow impedance. Measurements were performed in the absence of gross fetal body or breathing movements, and at similar heart rate in all groups. Indications for delivery were fetal (non-re assuring non stress test or biophysical profile ≤ 4), or maternal (like headache, blurred vision, epigastric pain, signs of severe pre-eclampsia). Average gestational age at delivery, time interval between the last Doppler examination and delivery, birth weight, Apgar score at 0 and 5 minutes after birth were recorded. Neonatal morbidity will be established if Apgar score < 6 at 5 minutes and neonatal acidemia of pH<7.2. Birth weight and maturity were estimated by the 1991 US national population; preterm birth was defined as gestational age of <37 completed weeks. Low birth weight was defined birth weight of <2500 g, by using the tables of Alexander and his associates 1996.[9]

Data was analyzed using SPSS program version 16. Descriptive statistics including means, standard deviation, frequencies, and percentages were obtained for all variables as appropriate. *P* value < 0.05 considered significant.

Verbal informed consent was obtained from all participants during their follow up at clinic and data confidentiality was maintained throughout the study and any resulting publication anonymously.

RESULTS

A total 402 patients were included in this study, their age ranged from 20-45 years old with mean age of 30.20±0.22 years. It was found that the perinatal death frequency was 6.5%, 18 babies in the gestational age between 32-34 weeks, and 8 babies in the group of gestational age between 34-36 weeks, and all the babies with their mothers in term pregnancy 37-38 weeks (Table 1).

Table 1: Distribution of cases according to gestational age and perinatal outcomes

Gestational age	With mother	Perinatal death	Total
32-34	214 (92.2%)	18 (7.8%)	232(100%)
35-36	126(94%)	8(6%)	134(100%)
37-38	36 (100%)	0 (0%)	36(100%)
Total	**376 (93.5%)**	**26(6.5%)**	**402(100%)**

Patients were divided into three groups according to their serum uric acid level; there were 164 patients with uric acid level <5 mg/dl with perinatal mortality rate 2.4% , 216 patients with perinatal mortality rate 7.4% among group with uric acid level between 5-7 mg/dl. High uric acid level >7 mg/dl was reported in 22 patients with perinatal mortality rate 27.2% (Figure 1).

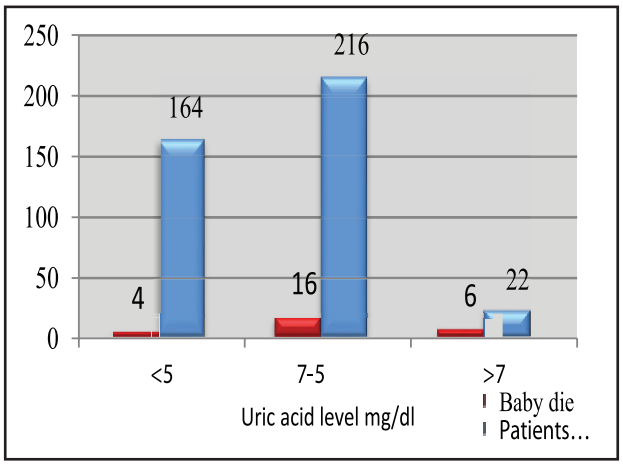

Figure 1: Distribution of perinatal outcomes according to uric acid level

The majority of UMAPI centile between 5th and 95th centile, 204 babies with perinatal mortality rate 6% (n = 12 babies), and 195 babies with umbilical artery PI centile >95th centile had perinatal death 7.2% (Table 2).

Table 2: Distribution of UMAPI centile and perinatal outcome

Centile	With mother	Perinatal death	Total
<5th	3(100%)	0)0%)	3(100%)
5th - 95th	192 (94%)	12(6%)	204(100%)
>95th	181(92.8%)	14(7.2%)	195(100%)
Total	**376 (93.5%)**	**26(6.5%)**	**402(100%)**

The study showed that, 23 babies with MCAPI<5th centile had very high rate of death (52.2%) and 379 babies were MCAPI between 5th - >95th centile with low mortality rate (3.7%) (Table 3).

Table 3: Distribution of MCAPI centile and perinatal outcome

Centile	With mother	Perinatal death	Total
<5th	11 (47.8%)	12(52.2%)	23(100%)
5th - >95th	365 (96.3%)	14(3.7%)	379(100%)
Total	**376 (93.5%)**	**26(6.5%)**	**402(100%)**

The majority (385) of babies birth weight in this study was found to be between 5th- 95th centile, with mortality rate of 5.9% (n = 23 babies), and 15 babies were <5th centile (low birth weight according to gestational age) with mortality rate 20% and two babies >95thcentile and both babies with their mothers (Table 4).

Table 4: Distribution of birth weight centile and perinatal outcome

Centile	With mother	Perinatal death	Total
<5th	12(80%)	3 (20%)	15(100%)
5th - 10th	56(95%)	3(5%)	59(100%)
<10th -50th	257(93%)	19(7%)	276(100%)
>50th -90th	49(98%)	1(2%)	50(100%)
>90th -95th	0 (0%)	0(0%)	0(0%)
>95th	2(100%)	0(0%)	2(100%)
Total	**376 (93.5%)**	**26(6.5%)**	**402(100%)**

High mortality rate with a low Apgar score at 5 minutes of delivery was found 68.4% (Table 5).

Table 5: Distribution of Apgar score at 5 minute of delivery and perinatal outcome

Apgar score	With mother	Perinatal death	Total
5	6(31.6%)	13(68.4%)	19(100%)
6	5(38.5%)	8(61.5%)	13(100%)
7	8(89%)	1(11&)	9(100%)
8	76(97.4%)	2(2.6%)	78(100%)
9	181(99%)	2(1%)	183(100%)
10	100(100%)	0(0%)	100(100%)
Total	**376 (93.5%)**	**26(6.5%)**	**402(100%)**

DISCUSSION

Fetal arterial Doppler studies are useful in the differential diagnosis of small-for gestation fetuses. In the hypoxemic group, due to impaired placental perfusion, the UMAPI is increased and the fetal MCAPI is decreased; consequently, the ratio of PI between the umbilical artery and middle cerebral artery is increased.[10–13] In the current study, most of patients were between 20-45 years old, with mean age of 30 years. In accordance with Meler et al study, which reported the mean age was 31.5 years.[14] More perinatal death with preeclampsia at 32-34 weeks, with no perinatal death at 37-38 weeks were noticed among our patients; which going with Norwegian study at 2015 they found a remarkably high relative risk of fetal death among pregnancies diagnosed with pre-eclampsia in the preterm period. [15]The use of Doppler umbilical waveforms as a fetal surveillance test had gained a wide popularity, especially in high-risk cases.[16] Regarding uric acid level we found 22 patients in our study with high uric acid level more than 7 mg/dl, have high perinatal mortality more than 27%. This finding was similar to results of the study in India, which showed there is a positive correlation between uric acid level and the severity of pre-eclampsia,

and a significant adverse fetal outcome is observed with raised maternal serum uric acid in pre eclamptic patients.[17] In this study an UMAPI when more than 95th centile was with higher perinatal mortality than when it less than 95th centile supported by Romero Arauz et al in Spanish study 2008 which show an abnormal Doppler umbilical artery waveform is associated with poor perinatal outcome and it is a strong predictor of perinatal mortality. [18] In present study, there was less perinatal mortality with birth weight between 5th-95th centile and no fetal death when birth weight more than 95th centile; which simultaneously with different in UMAPI and high mortality rate with low Apgar score at 5 minutes. This also supported by Romero Arauz et al, that showed neonates with abnormal pulsatility index had a lower birth weight (1,174 *vs* 1,728 g), lower Apgar score at 5 minutes, higher admission to the neonatal intensive care unit (86.4 *vs* 43%), and significant neonatal morbidity compared with those with normal velocimetry ($P < 0.05$). There were no perinatal deaths with normal umbilical Doppler waveform.[18]

Perinatal mortality significantly increase with MCAPI less than 5th centile was noted. This finding is consistent with study done in Turkey; both abnormal umbilical Doppler indices and cerebral-umbilical ratio are strong predictors of IUGR and of adverse perinatal outcome in preeclampsia, the combination of umbilical and fetal cerebral Doppler indices may increase the utility of Doppler ultrasound in pre eclamptic patients.[19]

CONCLUSION

The study concludes that Doppler ultrasound provides a non-invasive method for the study of fetal homodynamic investigation of the umbilical and middle cerebral arteries; gives information on the perfusion of the fetoplacental circulation and perinatal outcome. MCAPI is more sensitive for the perinatal outcome.

RECOMMENDATIONS

Further prospective studies should be undertaken that also include the Doppler evaluation of venous vessels.

REFERENCES

1. Nicolaides KH and Sebire NJ. (2015) Management of the red cell isoimmunized pregnancies. In: Kurjak A, Chervenak FA. Text book of perinatal medicine. 3rded. New Delhi, India: Jaypee Brothers Medical Publishers (P) Ltd.p.959

2. Surico D, Bordino V, Cantaluppi V, Mary D, Gentilli S, Oldani A, et al. (2019) Preeclampsia and intrauterine growth restriction: Role of human umbilical cord mesenchymal stem cells-trophoblast cross-talk, *PLoSOne* 14(6), e0218437.

3. Han VKM, Seferovic MD, Albion CD and Gupta MB. (2012) Intrauterine growth restriction: Intervention strategies. In: Buonocore G, Bracci R., Weindling M [Eds,]. Neonatology: A Practical approach to Neonatal Diseases. Milano, Italy: Springer-Verlag Italia. p. 90.

4. Magriples U. (2018) Intrauterine growth restriction. In: Copel JA, D'Alton ME, Feltovich H, Gratacós E, Krakow D, Odibo AO, et al [eds.]. Obstetric imaging: fetal diagnosis and care.2nd ed. Philadelphia: Elsevier inc.p.470-472.

5. Meyberg GC, Solomayer EF, Grischke EM and Bastert G. (1999) Does the measurement of four fetal arteries provide more than the measurement of just two arteries in prenatal Doppler sonography?. *Ultrasound ObestetGynecol*. **13**, 407-414.

6. Krishna U and Bhalerao S. (2011) Placental insufficiency and fetal growth restriction, *JObstetGynecolo India* **61**(5), 505-511.

7. Valcamonico A1, Danti L, Frusca T, Soregaroli M, Zucca S, Abrami F, et al. (1994) Absent end-diastolic velocity in umbilical artery: risk of neonatal morbidity and brain damage, *Am J Obstet Gynecol.* **170**(3), 796-801.

8. Gudmundsson S, Tulzer G, Huhta JC and Marsal K. (1996) Venous Doppler in the fetus with absent end-diastolic flow in the umbilical artery, *Ultrasound ObstetGynecol*. **7**, 262-267.

9. Sharma D, Shastri S and Sharma P. (2016) Intrauterine growth restriction: Antenatal and postnatal aspects, *Clin Med Insights Pediatr*. **10**, 67-83.