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ORIGINAL ARTICLE

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Umbilical and cerebral arterial flow velocity waveforms and neonatal outcome in high risk pregnancy

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OBJECTIVE(S) : To examine the role of fetal arterial Doppler in neonatal outcome

METHOD(S) : Seventy consecutive women with high-risk pregnancy were enrolled in the study group and 70 women with no obstetric complication were enrolled as control group. Both groups were subjected to serial ultrasonography and doppler studies of the umbilical and middle cerebral artery. Neonatal outcomes were recorded. Statistical analysis included mean ± SD and median (centiles). Z test was used as test of significance.

RESULTS : Perinatal morbidity and mortality were significantly higher in the study group. Sixteen (22.85%) neonates in study group required neonatal intensive care unit admission. Cesarean section was required in 25 (35.71%) subjects as compared to 16 (22.85%) controlss.

CONCLUSION(S) : Although fetal Doppler studies have an important role to play in the assessment and optimal timing of delivery, they do not appear to be independently associated with neonatal outcome.

Key words : Doppler hypertension, small for gestation, perinatal, outcome.

Introduction

Perinatal complications have been found to be statistically correlated with abnormal indices of flow resistance suggesting a potential role of doppler ultrasound in the management of high-risk pregnancies [1]. No evidence has emerged to support the use of doppler studies in the general obstetric population, however, it is mainly of use in a selected group of women, namely those with hypertensive diseases and/or those where a small for gestational age (SGA) fetus is suspected.

Intrauterine growth restriction (IUGR) is associated with significant perinatal mortality and morbidity. Adequate management of this condition requires an early recognition of fetuses that are SGA. The SGA fetus (defined as birth weight < 10th centile) is at increased risk of perinatal morbidity. Only a proportion of these may be growth restricted and therefore at greater risk of fetal distress in labor, hypoglycemia, hypothermia and admission to neonatal intensive care unit (NICU).

One of the main challenges is to distinguish normally nourished small fetuses from those with IUGR secondary to malnutrition and uteroplacental insufficiency. Accurate assessment of fetal condition may have favorable effects on perinatal outcome, in that fetuses may be delivered before the occurrence of irreversible damage.

Methods

This study was conducted over a period of one year. Seventy women with preeclampsia (PE) and small for gestational age (SGA) fetuses were consecutively enrolled into the study group; another 70 women with no obstetric complications and singleton pregnancy were enrolled in the control group. The characteristics of subjects in the study group were follows :

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1. Singleton pregnancy, gestational age of 28-40 weeks based on reliable last menstrual period (LMP) and/or a dating scan in the first trimester.
2. PE with or without clinical evidence of an SGA fetus. Mild PE was defined as diastolic blood pressure (DBP) of 100mm of Hg and urine albumin of 1±/trace and severe PE was defined as DBP >110 mm of Hg and urine albumin $\geq 2\pm$ [2].
3. Clinical evidence of an SGA fetus detected on serial symphysiofundal height (SFH) over 3 consecutive antenatal visits.
4. Major congenital anomalies excluded by a previous anomaly scan.

The controls were selected such that they matched the women in the study group for the gestational age, parity and maternal age, and had no high-risk factors.

In the study group, 28 subjects had PE alone, 11 had an SGA fetus without PE and 31 had both PE with an SGA fetus.

Antenatal care was given at each visit by the first author and the increased in symphysiofundal height blood pressure, and urine albumin examination was noted. Women were subjected to Doppler studies of the umbilical artery (UA) and middle cerebral artery (MCA) serially between 28 and 40 weeks, upto a maximum of 3 scans. These assessments were performed by the same observe using a commercial ultrasound machine, the Siemens G-60/S and a 3.5 to 5MHz curvilinear probe. The filter was set at 100 Hz. All measurements were plotted graphically in accordance with normograms provided by Hadlock et al [3] for biometry and that by Arduini and Rizzo [4] for Doppler indices.

Doppler readings were taken in the absence of fetal movements and fetal breathing. Velocity waveforms from the UA were obtained from a free loop of cord equidistant from the abdominal and placental insertion points. MCA was insonated at the level of the greater wings of sphenoid, the artery being identified as a major branch of circle of Willis. The angle of insonation in both cases was less than 60^0. Both pulsatility index (PI) and S/D ratio were recorded. In this paper, the readings for PI have been used. The mode of delivery, complications, Apgar, score and fetal weight were noted. The maturity of the baby after birth was calculated by the maturity score of Singh [5].

Statistical Analysis

Results are reported as mean ± SD and median (centiles) 3rd, 5th, 10th, 50th and 95th. The Z test was used as a test of significance and a P value of < 0.05 was considered significant.

Results

Table 1 shows the neonatal outcome by distribution of doppler values across the 5th, 50th and 95th centiles. With comparing neonatal outcome with the umbilical artery PI centiles, it was seen that 32 subjects and 50 controls had values at the 50th centile. Twenty-eight cases (45.71%) and 17 controls (71.42%) had values at the 95th centile. Of the 32 neonates (24.28%) at 50th centile in the study group, 14 (43.75%) were SGA and of the 28 neonates at the 93th centile, 13 (46.45%) were SGA.

Table 1. Neonatal outcome by Doppler values (in percentiles).

Doppler index by centile	Cases			Controls (n=70)
	Alive (n=65)		Stillbirth (n=5)	
	Appropriate for gestational age	Small for gestational age		
		Umbilical artery		
< 5th (n=13)	5	2	3	3
50th (n=82)	16	14	2	50
95th (n=45)	15	13	-	17
Absent end diastolic flow	1	5	4	-
		Middle cerebral artery		
5th (n=18)	7	5	1	4
50th (n=86)	19	14	4	49
95th (n=36)	8	11	-	17

Thirty-seven subjects (52.6%) had MCA PI values at 50th centile. Of these, 14 (37.8%) delivered SGA babies and 19 (51.35%) delivered appropriate for gestation (AGA) babies. Nineteen subjects (27.14%) had MCA PI values at 95th centile, of which 11 (57.9%) delivered SGA babies and 8 (42.1%) delivered AGA babies. In the control group 49 (70.0%) had MCA PI values at 50th centile and 17 (24.25%) at 95th centile.

There were five stillbirths in the study group and none in the control group. Of these five, three fetuses had UA PI values at 3rd centile and two at 50th centile. The MCA PI value was at 3rd centile in one fetus and at 50th centile in 4 fetuses. There were 10 fetuses with absent end diastolic flow (AEDF) in the UA, of which four were stillborn, five were SGA and one was AGA. **Figure 1 and 2** shows the scatter of cases by UA PI and MCA PI values along the 3,5.10, 50 and 95 centiles respectively.

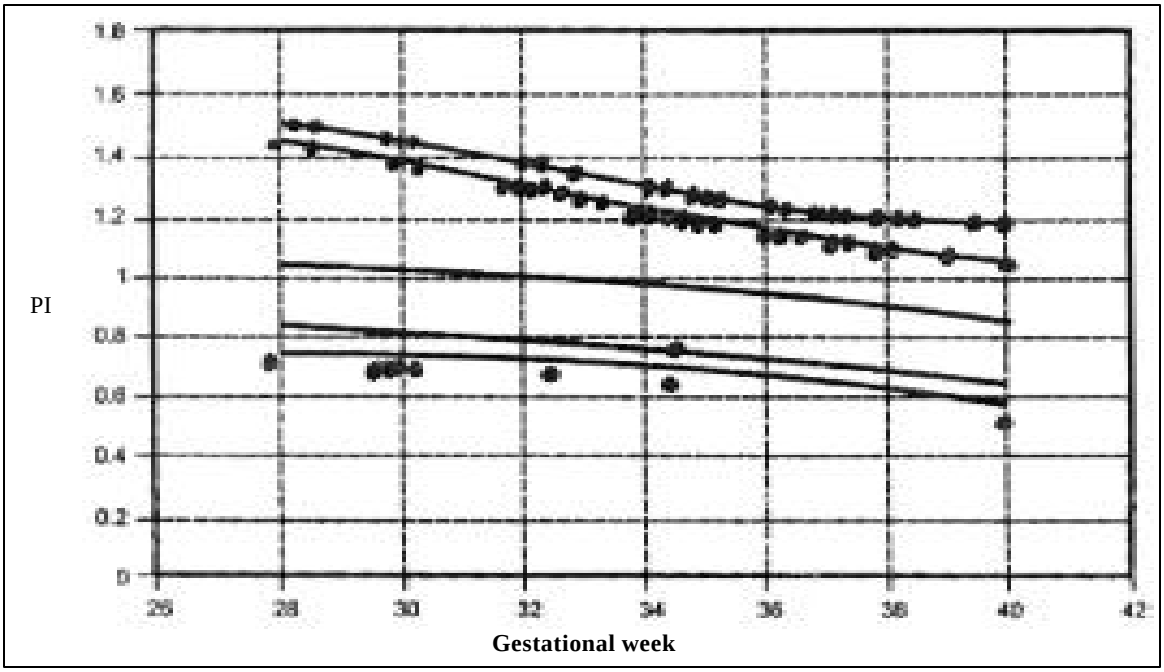

Figure 1. Umbilical artery Pulsatility Index (PI) nomogram : * indicates cases Lines indicate 3rd percentile, 5th percentile, 10th percentile, 50th percentile and 95th percentile respectively.

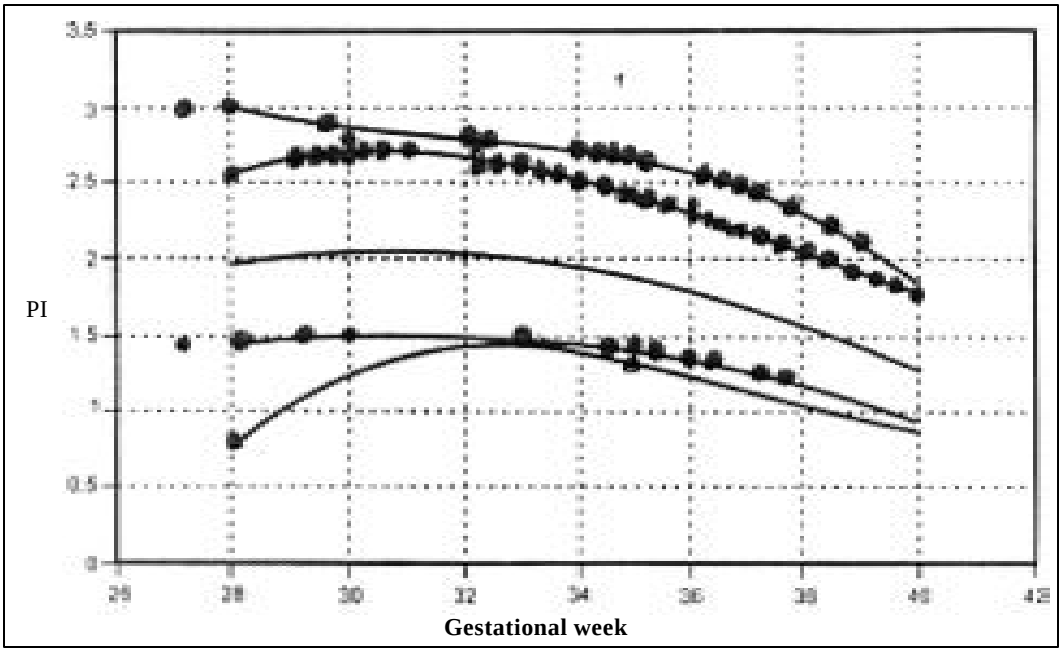

Figure 2. Middle cerebral artery Pulsatility Index (PI) nomogram : * indicates cases Lines indicate 3rd percentile, 5th percentile, 10th percentile, 50th percentile and 95th percentile respectively.

Table 2 shows the mode of delivery. Twenty-nine (41.4%) subjects and 44 (62.785%) controls had spontaneous vaginal delivery. Twenty-five (35.7%) subjects and 18 (22.85%) controls delivered by cesarean section. Sixteen (22.85%) subjects and 8 (11.4%) controls required indution of labor. The indications for induction in the control group were premature rupture of membranes and prolonged latent phase, whereas in the study group they were severe PE with or without oligohydramnios. In the subjects with stillbirths, labor had been induced at 30 weeks gestation for severe PE with oligohydraminios and AEDF in UA. Four women in this group delivered vaginally and one underwent cesarean section for intrapartum fetal distress.

Table 2. Mode of delivery

Mode of delivery	Cases (n=70)	Control (n=70)
Spontaneous vaginal delivery	29 (41.2)	44 (62.85)
Forceps delivery	00	2 (0.3)
Elective Cesarean delivery	11 (15.78)	—
In Labour	14 (20.0)	16 (22.85)
Induced labor	16 (22.85)	8 (11.42)

Figures in brackets represent percentage

Table 3 shows the perinatal outcome. Mean gestational age at delivery in the study group was 35.6 ± 3.4 weeks and in the control groups this was 38.72 ± 1.49 weeks. The mean birth-weight in the study and control groups were 2.0742 ± 0.636 and 2.4828 ± 0.457 g respectively. Both these observations were statistically significant at $P < 0.05$. Sixteen neonates in the study group required NICU admission, of which 11 required to be admitted for more then 48 hours. The mean duration of NICU stay was 5.44 days. Seven neonates had acidosis, two had periventricular haemorrhage and one had hypoglycemia (blood sugar < 35 mg/dL). There was two early neonatal deaths in addition to the five stillbirths in the study group.

Discussion

Perinatal morbidity and mortality were significantly greater in the study group as compared to the control group. In the study group, 36 subjects (51.42%) had an SGA fetus on clinical examination. There were five stillbirths and two early neonatal deaths in this group and 16 (22.85%) required NICU care. Umbilical artery AEDF was observed in 10 subjects, of whom four delivered stillbirths. The UA PI was < 5th centile in three women, all of whom had a stillbirth. Of the two perinatal death, one subject had normal UA PI at 50th centile, and one had UA PI at 3rd centile with AEDF. McCowan et al [6] observed that the odds of SGA babies with normal UA doppler study being admitted to the nursery was 3.3 times

Table 3. Perinatal outcome

Perinatal outcome	Subjects (n=70)	Controls (n=70)	P value
Gestational age at delivery in weeks Mean±SD	35.6 ± 3.4	38.72± 1.4	<0.05
Birth-weight in g Mean ± SD	2.0742 ± 0.636	2.482 ± 0.457	<0.05
Admission to NICU	16 (22.85)	-	
NICU admission > 48 hours	11 (15.7)	-	
Early neonatal deaths	02 (2.85)		
Periventricular hemorrhage	02 (2.85)		
Acidosis	07 (10.0)	-	
Hypoglycemia	01 (1.4)	-	
Mean duration of NICU stay (days)	5.44	-	
Stillbirth	05 (7.14)	-	

NICU - Neonatal intensive care unit

that of babies in the hospital population matched for gestation. They also found that when birth-weight and gestational age at delivery were controlled, for, abnormal UA doppler status was not an independent predictor of newborn nursery admission. Thus it appear that UA doppler study reflects disease severity but is not independently associated with neonatal outcome.

Harrington et al [7], found that UA PI is typically elevated if IUGR and hypoxia occur before 34 weeks, but may remain normal if changes occur at or near term. The mean PI in the UA PI was 1.210 SD higher in the SGA group than in the normal group two weeks before delivery.

The pregnancies used to define normal outcome were a mixture of women from the routine obstetric population,with no known complication in current pregnancy and they delivered AGA babies. While they represented the control group in the study, they do not necessarily represent the norm for every other population.

Conclusion

Fetal doppler studies have an important role to play in the assessment of fetal well being because the changes occur at a time when other tests are still normal. However, fetal arterial doppler studies do not appear to be independently associated with neonatal outcome.

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