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Original article

Prediction of perinatal outcome in IUGR Fetuses: Emerging role of MCA-PSV Doppler studies

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ABSTRACT

Objective: To determine the diagnostic performance of fetal Middle cerebral artery (MCA) – Peak Systolic velocity (PSV) for prediction of adverse perinatal outcome in Intauterine growth restriction (IUGR) fetuses and to determine the longitudinal trends in MCA-PSV in IUGR fetuses. **Methods:** Hospital based cohort study of 40 IUGR fetuses (gestation age 28-36 weeks, Estimated Fetal Weight (EFW)< 10th percentile, Umbilical artery-Pulsatility index (UA-PI>95th percentile) in whom MCA-PSV values were obtained on three or more occasions from the time of admission till delivery depending upon period of gestation and severity of IUGR. MCA-PSV values were considered abnormal when they were above the 95th percentile for MCA-PSV range. For analysis purpose two groups were made of twenty patients each depending upon MCA-PSV. **Results:** All the fetuses (100%) in group B (i.e. with abnormal MCA-PSV) had adverse perinatal outcome in the form of either mortality or major neonatal complication consisting of Newborn Intensive Care unit (NICU) stay ≥ 14 days, requirement of artificial ventilation or presence of intraventricular hemorrhage, respiratory distress or sepsis. Sensitivity &Specificity of abnormal MCA-PSV in predicting adverse perinatal outcome was found to be 90.91% & 100%. When followed longitudinally, in the three fetuses having fetal death, the PSV showed an initial increase in velocity followed by a fall prior to demise, thus suggesting that it could be a pre-terminal event. **Conclusion:** Fetal MCA-PSV appears to be a reliable indicator of adverse perinatal outcome in growth restricted fetuses with high sensitivity & specificity.

KEYWORDS: IUGR, MCA-PSV, Neonatal-outcome, IUD & NICU stay.

INTRODUCTION

Intauterine growth restriction (IUGR) is considered as a major contributor to perinatal morbidity and mortality, affecting 3-10% of all pregnancies. The timing of delivery of an IUGR baby has always posed a challenge to the obstetrician. It is important to identify the growth restricted fetuses that are at imminent risk of perinatal death from those that are not. This has been made possible by Doppler studies which have become the gold standard in the management of growth restricted fetuses and aids in decision making.

Umbilical artery and middle cerebral artery are the most frequently studied vessels and are good predictor of growth restricted fetuses at risk of antenatal compromise[1]. This study aimed to determine the diagnostic performance of fetal Middle cerebral artery (MCA) – Peak Systolic velocity (PSV) for prediction of adverse perinatal outcome in IUGR fetuses and to determine the longitudinal trends that occur in MCA-PSV in IUGR fetuses.

MATERIALS AND METHODS

This study was a hospital based cohort study done after approval by the Ethics committee. Forty pregnant women with singleton pregnancy with IUGR and who fulfilled the following inclusion criteria were enrolled in the study-

1.Period of gestation ≥28 weeks and <36 weeks

2.Estimated fetal weight <10th percentile &

3.Umbilical artery- pulsatility index (UA-PI) >95th percentile.

4.Women with fetuses showing congenital anomalies were excluded from the study.

Informed written consent was obtained from the mothers prior to enrolment. These women were further subjected to Doppler studies of MCA-PSV using standard techniques. MCA-PSV values were considered abnormal when they were above the 95th percentile for MCA-PSV range.

For analysis purpose two groups were made of 20 patients each.

Group A i.e. IUGR patients with normal MCA PSV.

Group B i.e. IUGR patients with abnormal MCA PSV.

Doppler studies of UA and MCA were repeated depending on period of gestation and severity of IUGR.

Ultrasonography along with Doppler study were performed using two systems- ALOKA (Alpha -6 MO2552 LI) or Toshiba (SSA-510A) by transabdominal method using trans-abdominal probe of 2-5 Mhz. The MCA was visualized in transverse axial view of fetal head at a slightly caudal plane than one used for biparietal diameter measurements. All recordings were obtained in the absence of fetal breathing and fetal movement.

Indications for delivery were: Abnormal fetal heart tracing, Absent diastolic or reversal of diastolic flow in umbilical artery, worsening of maternal condition like preeclampsia, gestational age > 34 weeks in patients with high resistance diastolic flow and amniotic fluid index less than five.

Steroids were administered (Inj. Betamethasone 12 mg i.m. stat followed by repeat dose after 24 hours) to all the women between 28 to 36 weeks to enhance fetal lung maturity. Induction of labour was done depending upon the Bishop's Score. Emergency caesarean section was done whenever fetal distress developed. Elective caesarean was done for associated fetal and obstetric indications.

Neonatal outcomes which were assessed included Gestational age at birth. Birth weight of newborn, APGAR score at 5 min, Stay in NICU, Condition on discharge from NICU and Adverse perinatal outcome. Adverse perinatal outcome was described by the following end points- perinatal or Neonatal mortality & major neonatal complications like intra- ventricular hemorrhage, respiratory distress or sepsis or prolonged NICU stay for>14 days.

Data gathered was then statistically analyzed using Microsoft excel and SPSS software. Difference in proportion was analysed using chi-square tests while difference in mean was inferred by unpaired "t" test. Significance level for tests was determined as 95% (P <0.05).

RESULTS

The two groups were comparable when age, religion, residence, literacy, socioeconomic status and gravida status was considered. 85% of women in group A and 75% in group B had cesarean section. There were 5 vaginal deliveries out of 20 in group B of which 3 were IUFD and the other 2 were delivered vaginally because of patient refusal for cesarean section. Neonatal outcomes in terms of Live birth, IUFD, Birth weight (in kg) , APGAR score at 5 min , mean duration and prolonged stay(>14 days) in NICU and associated neonatal mortality are shown in Table 1.

Table :1 Differences in Neonatal outcomes of Patients having Normal & Abnormal MCA-PSV

OUTCOME	**Group-A** (Normal MCA-PSV) (N=20)	**Group-B** (Abnormal MCA-PSV) (N=20)	**P-VALUE**
Mean Gestational Age at delivery (in weeks)	36.10 ± 0.91	34.20 ± 1.36	**<0.001**
Intra uterine Death	0 (0%)	3 (15%)	-
Live birth	20 (100%)	17(85%)	NS
Nursery Observation	12 (60%)	0 (0 %)	**0.00003467**
NICU admission	8 (40%)	17(100%)	
Mean Duration of Stay in NICU (in days)	9.37 ± 6.37	14.64 ± 8.47	**<0.05**
Prolonged NICU stay (>14 days)	2 (10%)	16 (94.1%)	**0.00003601**
Neonatal Mortality	0 (0%)	1 (5.9%)	-
Birth Weight of newborn (in kg)	1.99 ± 0.38	1.54 ± 0.35	**< .001**
APGAR Score(at 5 Min) < 7 days	14 (70%)	20 (100%)	**0.007**

The association of abnormal MCA Doppler with adverse perinatal outcome was found to be significant for PSV (P-value < 0.05). Specificity for abnormal MCA-PSV was found to be 100% which implies that presence of abnormality of MCA-PSV is associated with high chances of adverse perinatal outcome Table 2. The fetuses were monitored longitudinally and serial Doppler studies were performed depending upon the period of gestation and severity of fetal growth restriction. MCA PSV values were plotted against normal reference ranges. Of the 40 IUGR

fetuses, all underwent serial ultrasound examinations and the MCA-PSV were recorded longitudinally from the time of diagnosis of fetal growth restriction was made until delivery. The number of measurements in each fetus ranged from 2 to 5 (median 3).

Table: 2 Association of abnormal MCA-PSV with adverse perinatal outcome

Doppler Parameter	Adverse Perinatal Outcome (n=22)	No Adverse Perinatal Outcome (n=18)	P- value	Sensitivity (%)	Specificity (%)	Positive Predictive Value	Negative Predictive Value
Group A Normal MCA-PSV (5^{th}-95^{th} percentile)	2	18	<0.05	90.91%	100%	100%	90%
Group B Abnormal MCA -PSV (>95^{th} percentile)	20	0					

DISCUSSION

The mean gestational age at the time of delivery in Group-A was 36.10 ± 0.91 weeks and that in Group-B was 34.20 ± 1.36 weeks (p value <0.001). Thus, supporting that abnormal MCA Doppler waveforms result in delivery at an earlier gestation and hence contributing to poor perinatal outcome.Bukowski R [2] observed that almost 30% of fetuses born before 35 weeks were under the 10^{th} percentile for birth weight compared to only 4.5% of the fetuses born at 37 weeks or later.

In a study by Nalini YL [3] it was observed that 35% cases with abnormal UA and MCA Doppler waveforms required NICU admission whereas only 5% cases with normal Doppler flow were shifted to NICU. The mean duration of NICU stay in Group-B was 14.64 days which was significantly more than that in Group-A i.e. 9.37 days (p-value<0.05). Our findings are in accordance with the study conducted by Dhand H [1] in which neonates with abnormal MCA Doppler were more than twice as likely to be admitted in neonatal intensive care unit that the neonates with normal Doppler waveforms.

The mean birth weight (1.99 kg v/s 1.54 kg) was significantly lower in patients who had adverse MCA-PSV as compare to those having normal MCA-PSV (p-value<0.001). Birth weight in particular is strongly associated with fetal, neonatal and post neonatal mortality, infant and childhood morbidity and long term growth and development as stated by McCormick MC, WHO technical report series [4, 5]

In Group-A, 14 (70%) babies had APGAR score (at 5 min) <7 while in Group-B 100% babies had APGAR score (at 5 min) <7 (p-value-0.007). A previous study conducted by Dhand H [1] also concluded that abnormal Doppler velocities were associated with a low 5 min APGAR score. MCA-PSV showed an increase with gestational age in most of the study subjects. In the fetuses having fetal death, the PSV showed an initial increase in velocity beyond the 95^{th} percentile followed by a fall prior to demise however, the value remained above the upper limit of normal.

In the patients who had at least three recordings of Doppler parameters prior to delivery, association of a fall in MCA-PSV was studied as a predictor of fetal death. All 3 IUGR fetuses who had intrauterine demise had such fall in MCA-PSV prior to fetal death. Thus, the specificity of fall of MCA-PSV for predicting fetal death was high suggesting that it could be a pre-terminal event and termination of pregnancy may be contemplated when this situation is documented to prevent perinatal mortality. In the other fetuses (who did not have mortality) MCA-PSV had the highest value just before birth. PSV is a parameter that has been less investigated in FGR fetuses. Study conducted by Ozcan T [6] reported that the MCA PSV is increased in IUGR fetuses suggesting that it could be a good predictor of perinatal mortality. Rizzo G [7] have also concluded that the middle cerebral artery peak systolic velocity increases in severely growth restricted fetuses and it remains elevated until a few hours prior to fetal demise.

The association of abnormal MCA Doppler with adverse perinatal outcome was found to be significant for PSV (P-value < 0.05). Specificity for abnormal MCA-PSV was found to be 100% which implies that presence of abnormality of MCA-PSV is associated with high chances of adverse perinatal outcome. Our findings are consistent with the study conducted by Mari G [8] which concluded that a high MCA-PSV predicts perinatal mortality better than does a low MCA-PI and proposed that MCA-PSV might be valuable in the clinical assessment of IUGR fetuses that have abnormal UA Doppler.

CONCLUSION

Fetal MCA-PSV appears to be a reliable indicator with high sensitivity and specificity in prediction of adverse perinatal outcome in growth restricted fetuses thus implying that

abnormality in MCA-PSV warrants stringent monitoring. Serial Doppler examinations of fetal MCA-PSV provide better information than does a single measurement. Doppler study of MCA-PSV should be used in the surveillance of IUGR fetuses together with currently used Doppler parameters so as to decide the optimal time for delivery permitting maximum maturity with minimal fetal hypoxia or acidosis and hence optimizing fetal outcome.

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