

Colour Doppler Evaluation of Third Trimester Middle Cerebral Artery & Umbilical Artery Flow Velocity Indices in Relationship to Perinatal Outcomes

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Abstract

Original Research Article

Background: Doppler ultrasound enables us to identify any circulatory problems causing utero-placental and fetoplacental insufficiency. The Middle Cerebral Artery (MCA) and Umbilical Artery (UmA) are the most commonly studied vessels in assessment of foetal wellbeing. In intrauterine growth retardation the umbilical artery and MCA are most commonly examined. **Aim:** To study role of MCA & Um A Doppler indices in predicting foetal outcome in third trimester pregnancy & to compare these indices regarding their utility. **Material & Methods:** Descriptive follow-up study was conducted in teaching hospital. Four hundred subjects in third trimester of pregnancy were included. Systematic random sampling technique was used. **Results:** Maximum number of patients belonged to age group of 22 to 25 years (51%). Maximum subjects had normal AFI (47.75%). At placental end of umbilical artery, 53.5% subjects had normal RI & 1.75% had abnormal RI with normal Apgar score. About 2.25% subjects had abnormal MCA RI while 53% had normal MCA RI with normal Apgar score. Highest specificity (99.54%) was noted in Pulsatility Index (PI) of Umbilical artery (placental end) & highest sensitivity (97.2%) was noted in Pulsatility Index (PI) of MCA. **Conclusion:** PI of umbilical artery & S/D ratio of MCA were having good specificity & sensitivity in combination. Doppler ultrasound is a safe & quick method to assess the foetal condition to prevent perinatal morbidity & mortality. **Keywords:** MCA, Resistive index (RI), Pulsatility Index (PI), Apgar score.

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INTRODUCTION

There are many causes of perinatal morbidity & mortality in spite of modern advances & facilities in ante natal care. Doppler ultrasound is non-invasive & rapid method of assessment. Doppler ultrasound helps to study the utero-placental and fetoplacental circulation and thus enables us to identify any circulatory problems causing utero-placental and fetoplacental insufficiency and thus foetal hypoxia [1]. No harmful effects are reported with Doppler till date in mid and late pregnancy [2]. Doppler is used in a complementary fashion with traditional methods in assessing biophysical profile with 2D ultrasound and non-stress test (NST).

The Middle Cerebral Artery (MCA) and Umbilical Artery (UmA) are the most commonly studied vessels in assessment of foetal wellbeing. In intrauterine growth retardation the umbilical artery and MCA are most commonly examined [3]. Doppler assessment of these indices was useful in predicting the neonatal wasting [4]. Statistically significant association between the Doppler waveform analysis and pregnancy

outcome. MCA & UmA Doppler studies led to prompt obstetric case management [5].

This study was planned to study role of MCA & UmA Doppler indices in predicting foetal outcome in third trimester pregnancy & to compare these indices regarding their utility.

MATERIALS & METHODS

A descriptive follow-up study was conducted in Department of Radio-diagnosis of DVP Medical College & Hospital, Nashik. The study conducted over a period of 2 years from January 2010 to December 2011 including analysis period. The study population comprised of 400 subjects in third trimester of pregnancy. Sample size was calculated using proportion of outcome variable mentioned in previous studies and rounded up to 400. Subjects were selected using systematic random sampling method. Inclusion criteria were patients in third trimester that could be followed up, registered & ready to give consent. Permission from Institutional Ethical Committee (IEC) was taken before data collection. Patients were informed verbally

regarding details of examination and written valid consent was taken from each patient.

A high resolution colour Doppler scanner (Acuson X-500) with 2-6 MHz curvilinear probe was used to study the various parameters in third trimester. Umbilical artery (UmA) study at various points (placental end, mid loop & foetal end) was studied for its spectral pattern & different indices. Middle Cerebral Artery (MCA) Doppler study was conducted in foetus for its spectral pattern and indices. Age, information about delivery outcome, foetal weight, Apgar score (AS), Amniotic fluid index (AFI) & Expected foetal weight were the other parameters that was been recorded. Doppler examination done in supine position & foetus in a quite resting state. Flow velocity waveforms were recorded from the foetal MCA & Umbilical artery. Standard operational definitions of Doppler velocities like Resistive Index (RI), Pulsatility Index (PI) & S/D ratio were fixed before study & used throughout the study [1, 6]. Follow up study of pregnancies & their results of outcome were correlated with Doppler study.

Data was entered in Microsoft Excel & analysed using SPSS software. Descriptive statistics like frequency, proportions, mean & standard deviation used at appropriate places. Table & graphs used to summarize the results. Sensitivity & specificity of various Doppler indices were calculated.

RESULTS

The study population comprised of 400 subjects in third trimester of pregnancy. Most of the subjects were for routine check-up, followed by those with complaints of pain, pregnancy induced hypertension, post-dated pregnancy & others. *Table no. 1* gives detail information about age wise distribution, gravida & Amniotic fluid index (AFI). Maximum number of patients belonged to age group of 22 to 25 years (51%) followed by 18 to 21 years of age (24.5%). Almost equal number of primigravida (50.25%) and multigravida (49.75) were study participants. Maximum

subjects had AFI between 8 to 18 centimetres i.e. 47.75% [Table no.1].

As shown in *figure no. 1*, maximum subjects had full term normal delivery (FTND) (61%) followed by elective LSCS (29%). Pre term vaginal delivery was least common (3.75%). Out of 400 deliveries, most common were normal birth weight babies (58.5%) followed by Low birth wt. babies (LBW) and still birth or intra uterine deaths (IUD). Apgar score was more than or equal to 7 in 55.25% patients followed by 4 to 6. [Figure no.1]

Table no. 2 highlights the details of relationship between Apgar score and Colour Doppler findings of Umbilical Artery (UmA) & Middle Cerebral Artery (MCA). These findings include Resistive index (RI), Pulsatility index (PI) and Systolic/ Diastolic ratio (S/D). At placental end of umbilical artery, 53.5% subjects had normal RI & 1.75% had abnormal RI with Apgar score between 7 & 10. About 2.25% subjects had abnormal MCA RI while 53% had normal MCA RI with Apgar score between 7 & 10. Two (0.5%) subjects with abnormal PI had an AS of 0; 220 (55%) subjects with normal PI has AS of 7 to 10. MCA PI was found to be normal in 9 subjects with AS 0 & was abnormal in 2 subjects with normal AS. The S/D ratio of umbilical artery at placental end was normal in 50.25% subjects & abnormal in 5% subjects with normal AS. It was normal in 0.75% subjects and abnormal in 1% subjects with AS of 0. The S/D ratio of MCA was normal in 54.7% subjects with normal AS & abnormal in 0.25% subjects with AS of 0. Out of 9 perinatal deaths, absent diastolic flow in UtA was seen in 1 subject and reversal of diastolic flow also seen in one patient [Table no. 2].

Table no. 3 gives clear evidence about sensitivity & specificity of Doppler indices of umbilical artery and MCA. Highest specificity (99.54%) was noted in Pulsatility Index (PI) of Umbilical artery (placental end) & highest sensitivity (97.2%) was noted in Pulsatility Index (PI) of MCA. PI of umbilical artery & S/D ratio of MCA were having good specificity & sensitivity in combination [Table no. 3].

Table-1: Characteristics of study participants (n=400)

		Frequency	%
Age groups (years)	18-21	98	24.5
	22-25	203	51
	26-31	84	21
	32-35	13	3
	>35	2	0.5
Gravida	Primi	201	50.25
	Multi	199	49.75
Amniotic Fluid Index (Cms.)	0-5	128	32
	6 to 7	80	20
	8 to 18	191	47.75
	>18	1	0.25

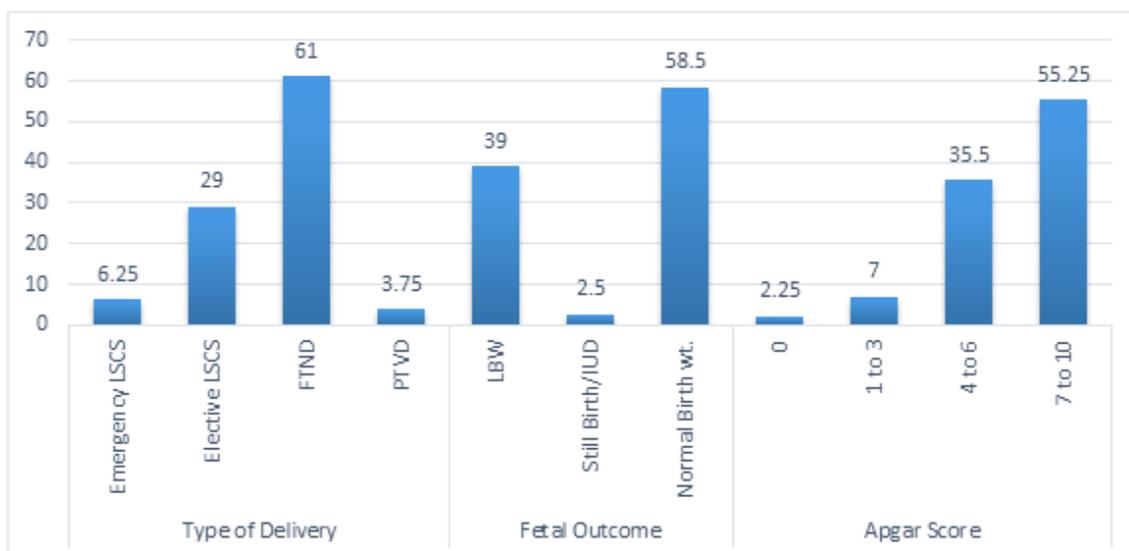


Fig-1: Maternal & Foetal outcome

Table-2: Foetal outcome (Apgar score) and Colour Doppler findings of Umbilical Artery (UmA) & Middle Cerebral Artery (MCA)

Colour Doppler indices		Apgar Score	0(%)	1-3(%)	4-6(%)	7-10(%)	Total (%)
RI (Resistive Index)	Umbilical Artery (at Placental end)	Normal (≤ 0.7)	2(0.5)	10(2.6)	128(32)	214(53.5)	354(88.5)
		Abnormal (>0.7)	5(1.25)	18(4.5)	14(3.5)	7(1.75)	44(11)
	Middle Cerebral Artery	Normal (≥ 0.7)	6(1.5)	26(6.5)	137(34.25)	212(53)	381(95.25)
		Abnormal (<0.7)	3(0.75)	2(0.5)	5(1.25)	9(2.25)	19(4.75)
PI (Pulsatility index)	Umbilical Artery (at Placental end)	Normal (≤ 1.5)	5(1.25)	28(7)	140(35)	220(55)	393(98.25)
		Abnormal (>1.5)	2(0.5)	0	2(0.5)	1(0.25)	5(1.25)
	Middle Cerebral Artery	Normal (≥ 1)	9(2.25)	28(7)	139(34.7)	219(54.75)	395(98.75)
		Abnormal (<1)	0	0	3(0.75)	2(0.5)	5(1.25)
Systolic/Diastolic Ratio	Umbilical Artery (at Placental end)	Normal (≤ 3)	3(0.75)	6(1.5)	101(25.2)	201(50.25)	311(77.75)
		Abnormal (>3)	4(1)	22(5.5)	41(10.25)	20(5)	87(21.75)
	Middle Cerebral Artery	Normal (≥ 3)	8(2)	26(6.5)	140(35)	219(54.7)	381(95.5)
		Abnormal (<3)	1(0.25)	2(0.5)	2(0.5)	2(0.5)	7(1.75)

Table-3: Sensitivity & Specificity of various Doppler indices

Indices		Sensitivity	Specificity
Umbilical Artery (at Placental end)	RI(Resistive Index)	78.21	96.83
	PI(Pulsatility index)	96.64	99.54
	S/D ratio (Systolic/Diastolic)	61.45	90.95
Middle Cerebral Artery	RI(Resistive Index)	94.4	95.2
	PI(Pulsatility index)	94.62	99.09
	S/D ratio (Systolic/Diastolic)	97.2	99

DISCUSSION

Present study was performed in teaching hospital. Four hundred pregnant women in their third trimester were study subjects. Doppler is cheap, non-invasive & easily accessible method to evaluate the foetal hemodynamic. The middle cerebral artery (MCA) & Umbilical arteries (UmA) are the most commonly studied vessels in assessment of foetal wellbeing [7]. In study done by Lakhkar *et al.* [8], mean maternal age was 27.3 years. Primipara was 60.3% & LSCS were

highest (62%). Results in our study were different from this study. Makhseed *et al.* [9] and Harneet *et al.* [3] reported similar trend of findings in their studies.

Normally as the gestational age increases the Doppler indices (RI, PI & S/D) in UmA falls indicating a progressive reduction in peripheral resistance. In increase in these values are suggestive of changes due to resistance at foetal level. The MCA normally has a high systolic velocity & minimal diastolic velocities

with high PI. In case of low oxygen tension, vascular tone in MCA is reduced, resulting in increased diastolic velocity & reduced PI values[10]. Study done by Bano *et al.* [7] noted that 1.5% with normal UmA PI & 14.7% abnormal UmA PI had abnormal AS. Our study noted that 43.5% with normal UmA PI & 1% abnormal UmA PI had abnormal AS. Bano *et al.* [7] also noted that 9.3% with normal MCA PI & 75% abnormal MCA PI had abnormal AS. Our study noted that 44% with normal MCA PI & 1% abnormal MCA PI had abnormal AS. Harneet *et al.* [3] reported 17% normal & 49% abnormal MCA indices with Apgar score <7.

Present study compared with Gramellini D *et al.* [5] who studied the cerebro-umbilical ratio as a predictor of adverse perinatal outcome. As compared to this study [MCA PI (24%) & UmA PI (64%), we obtained a higher sensitivity of MCA PI (94.62%) & UmA PI (94.64%). We also found that UmA PI was equally as sensitive as compared to MCA PI in predicting the adverse foetal outcome. In 2005, Mitko J Ivanovski [11] had lower sensitivity (68.9%) & specificity (77%) in MCA RI as compared to our study (sensitivity-94.62% & specificity-95.2%). Sieroszewski *et al.* [12] observed that the blood flow in MCA especially the PI had more specificity. Similar findings were noted in our study. Studies done by Szymanski *et al.* [13] & Mohd Khalid *et al.* [14] showed similar results.

Doppler ultrasound is a safe & quick method to assess the foetal condition to prevent perinatal morbidity & mortality. MCA and Umbilical artery Doppler indices appear to be the best predictor of poor perinatal outcome. So Doppler studies forms an important part of obstetrics examination.

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