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Role of Colour Doppler Ultrasound in Third Trimester Pregnancy to Predict Foetal Outcome

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Abstract **Original Research Article**

Background: Accurate management of the foetal blood flow & condition is important in order to prevent or reduce perinatal morbidity, mortality & unwanted intervention in pregnancy. Doppler velocimetry helps to identify normal and abnormal flow in foetal arterial and venous circulation. ***Aim:*** To evaluate the role Doppler in third trimester pregnancy to predict the foetal outcome, its role in predicting the need of intervention & to compare the role of different Doppler parameters. ***Material & Methods:*** An observational, descriptive follow-up study was conducted in our hospital. Various Doppler indices related to Umbilical & Uterine artery and DuctusVenosus were studied & compared for sensitivity & specificity. ***Results:*** Four hundred subjects in third trimester of pregnancy were study participants. Half of the subjects had normal Amniotic Fluid Index. Apgar score (AS) was more than or equal to 7 in 55.25% patients. Two (0.5%) subjects with abnormal PI had an AS of 0; 220 (55%) subjects with normal PI has AS of 7 to 10. The S/D ratio of uterine artery was normal in 50% subjects with normal AS & abnormal in 1% subjects with AS of 0. Among all best sensitivity (96.64%) & specificity (99.54%) was noted in Pulsatility Index (PI) of Umbilical artery (placental end). ***Conclusion:*** Umbilical artery Doppler &DuctusVenosus waveform indices appear to be the best predictor of poor perinatal outcome. Doppler ultrasound is one of the most important clinical tools of feto-maternal surveillance in pregnancy.

Keywords: DuctusVenosus, Uterine artery,Apgar score, Resistive index (RI), Pulsatility Index (PI).

INTRODUCTION

Accurate management of the foetal blood flow & condition is important in order to prevent or reduce perinatal morbidity, mortality & unwanted intervention in pregnancy. Doppler ultrasound enables us to identify any circulatory problems causing utero-placental and feto-placental insufficiency and thus foetalhypoxia [1]. No harmful effects are reported with Doppler till date in mid and late pregnancy [2]. Doppler velocimetry helps to identify normal and abnormal flow in foetal arterial and venous circulation.

The Umbilical Artery (UmA), uterine artery (UA) &Ductusvenosus (DV) are commonly studied vessels in assessment of foetal wellbeing. Doppler follows a longitudinal trend with early changes in umbilical artery followed by other peripheral arteries. Venous changes follow the arterial pattern and occur in severely compromised foetus and predicts poor perinatal outcome [3]. Neonatal outcome can be predicted by Doppler assessment of these indices [4]. Doppler waveform analysis and pregnancy outcome shows significant association. UmA, UA & DV Doppler studies led to efficient & timely case management [5].

This study planned at Radiology Department of our hospital, to evaluate the role Doppler in third trimester to predict the foetal outcome, its role in predicting the need of intervention & to compare the role of different Doppler parameters.

MATERIALS & METHODS

An observational, descriptive follow-up study was done in Radio-diagnosis Department of DVPM College & Hospital, Nashik. The study conducted over a period of 2 years from January 2010 to December 2011 including analysis period. Permission from Institutional Ethical Committee (IEC) was taken before data collection. Four hundred subjects in IIIrd trimester of pregnancy were the study population. Sample size was rounded up to 400 which were calculated using proportion of outcome variable mentioned in previous literature [3]. Systematic random sampling method was used to select subjects. Patients in third trimester who could be followed up, registered & ready to give

consent were included in the study. Informed written valid consent was taken from each patient.

Machine specifications were a high resolution colour Doppler scanner (Acuson X-500) with 2-6 MHz curvilinear probe that was used to study the various parameters in third trimester. Uterine artery (UA) study for its spectral pattern, diacritic notch 7 different indices was conducted. Ductusvenosus (DV) waveform was also studied. Umbilical artery (UmA) study at various points (placental end, mid loop &foetal end) was studied for its spectral pattern & different 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, UA notching &DV (Wv) were fixed before study & used throughout the study [1, 6]. Follow up study of pregnancies & their results of outcome were correlated with Doppler study.

Microsoft Excel was used for data feeding & SPSS software was used for analysis. Frequency, proportions, mean & standard deviation were the descriptive statistics used. The findings were summarized using tables & graphs. Sensitivity & specificity of various Doppler indices were calculated.

RESULTS

Four hundred subjects in third trimester of pregnancy were study participants. Figure no. 1 depicts detail information about age wise distribution, Amniotic fluid index (AFI) & parity. Highest number of patients belonged to age group of 22 to 25 years (51%) followed by 18 to 21 years of age (24.5%). Maximum subjects had AFI between 8 to 18 cms. i.e. 47.75%. Primigravida (50.25%) were slightly higher in number than multigravida (49.75). Routine check-up, followed by those with complaints of pain, pregnancy induced hypertension, post-dated pregnancy were the common reasons for visit [Figure no. 1].

Table no. 1 clearly depicts that out of 400 deliveries Apgar score (AS) was more than or equal to 7 in 55.25% patients followed by 4 to 6 (35.5%). Highest subjects had full term normal delivery (FTND) (61%) followed by elective LSCS (29%). Pre term vaginal delivery was least common (3.75%). Most common foetal outcome was normal birth weight babies (58.5%) followed by Low birth wt. babies (LBW) and still birth or intra uterine deaths (IUD). [Table no. 1].

Table no. 2 underlines relationship between Foetaloutcomes based on Apgar score and Colour Doppler findings of Umbilical Artery (UmA), uterine artery (UA) &DuctusVenosus (DV). These findings include Resistive index (RI), Pulsatility index (PI), Systolic/ Diastolic ratio (S/D), notching & DV waveform. In case of umbilical artery, 53.5% subjects had normal RI & 1.75% had abnormal 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. 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 uterine artery was normal in 50% subjects with normal AS & abnormal in 1% subjects with AS of 0. Notching was seen in 3.5% of the subjects & it was absent in 51.75% subjects with normal AS. About 1% subjects showed notching while notching was absent in 1.5% subjects with Apgar score of zero. The DuctusVenosus (DV) waveform was normal in 55% subjects and abnormal in 0.25% subjects with normal AS. It was normal in 0.5% and abnormal in 1.75% subjects with AS of zero. [Table no. 2].

Evidence about sensitivity & specificity of Doppler indices of umbilical artery, uterine artery &ductusvenosus are highlighted in table no.3. Among all best sensitivity (96.64%) & specificity (99.54%) was noted in Pulsatility Index (PI) of Umbilical artery (placental end). S/D ratio of uterine artery and DV waveform were also having good specificity & sensitivity but lower than that of PI of umbilical artery [Table no. 3].

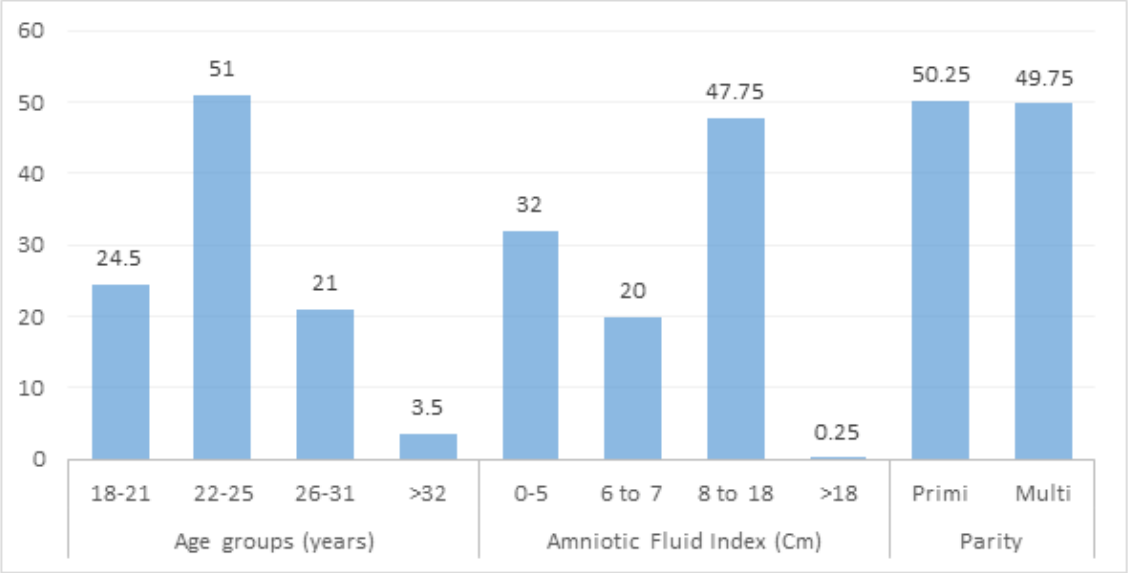

Fig-1: Study participants information (n=400)

Table-1: Delivery &Foetal outcome

Outcome		Frequency	%
Apgar Score	0	9	2.25
	1 to 3	28	7
	4 to 6	142	35.5
	7 to 10	221	55.25
Type of Delivery	Emergency LSCS	25	6.25
	Elective LSCS	116	29
	FTND	244	61
	PTVD	15	3.75
Foetal Outcome	LBW	156	39
	Still Birth/IUD	10	2.5
	Normal Birth wt.	234	58.5

Table-2: Foetal outcome (Apgar score) and Colour Doppler findings of Umbilical Artery (UmA), uterine artery (UA) &DuctusVenosus (DV)

	Apgar Score	0(%)	1 to 3(%)	4 to 6(%)	7 to 10(%)	Total(%)
UmA RI	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%)
UmA PI	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)
UmA S/D	Normal (≤3)	3(0.75)	6(1.5)	101(25.25)	201(50.25)	311(77.75)
	Abnormal (>3)	4(1)	22(5.5)	41(10.25)	20(5)	87(21.75)
UA S/D	Normal (≤3)	5(1.25)	25(6.25)	132(33)	200(50)	362(90.5)
	Abnormal (>3)	4(1)	3(0.75)	10(2.5)	21(5.25)	38(9.5)
UA notching	Present	3(0.75)	17(4.25)	65(16.25)	14(3.5)	99(24.75)
	Absent	6(1.5)	11(2.75)	77(19.25)	207(51.75)	301(75.25)
DV (Waveform)	Abnormal	7(1.75)	3(0.75)	3(0.75)	1(0.25)	14(3.5)
	Normal	2(0.5)	25(6.25)	139(34.75)	220(55)	386(96.5)

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
Uterine Artery	Notching	52.5	93.66
	S/D ratio (Systolic/Diastolic)	90.5	90.49
DuctusVenosus	Waveform	92.73	99.54

DISCUSSION

A hospital based study planned in Department of Radio diagnosis to evaluate role of Doppler indices in predicting foetal outcome. Four hundred subjects were part of the study. Colour Doppler ultrasonography is safe, quick, non-invasive & easily accessible method to evaluate the feto-maternal hemodynamic. The Umbilical arteries (UmA), Uterine artery &DuctusVenosus are the most commonly studied vessels in assessment of foetalwellbeing [7]. Studies done by Makhseeda *et al*. [8] and Harneet *et al*. [9] reported similar trend of findings. Lakhkar *et al*. [3] reported, mean maternal age was 27.3 years. LSCS were highest (62%) &Primipara was 60.3%. Results in our study differ from this study.

The diastolic component of uterine artery (UA) changes from a low peak flow with an early notch to that of high flow with no notch as the pregnancy progresses. Presence of notch with high PI values indicate resistance at utero-placental level. 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 foetallevel [10]. Study done by Bano *et al*. [11] 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. Low Apgar score (AS) was found in subjects with abnormal Um a Doppler than with Uterine Arteries or DuctusVenosus. Low AS was associated with raised UmA S/D ratio. Similar findings were noted by Khalid *et al*. [12] & Coleman *et al*. [7].

In our study, highest sensitivity shown by Umbilical artery PI while highest specificity shown by both i.e. UmA PI &Ductusvenosus waveform. But collectively among these indices, Umbilical artery Doppler indices was best for foetal outcome. Uterine artery notching had lowest sensitivity & specificity. UA S/D ratio was good Doppler indices than UmA S/D ratio. Gramellini D *et al*. [5] who studied the cerebro-umbilical ratio as a predictor of adverse perinatal outcome. Study done by Gramellini D *et al*. [5] reported UmA PI (64%) while we obtained a higher sensitivity of UmA PI (94.64%). We also found that UmA PI was equally as specific as compared to DV waveform in predicting the adverse foetal outcome. Studies done by Lakhkar *et al*. [3] & Coleman *et al*. [7] showed similar results.

Doppler ultrasound enables a better understanding of haemodynamic changes and has therefore become one of the most important clinical tools of feto-maternal surveillance in pregnancy. Doppler is cheap, non-invasive & easily accessible method. Umbilical artery Doppler &DuctusVenosus waveform indices appear to be the best predictor of poor perinatal outcome.

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