Original Article

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Role of Amniotic Fluid to Umbilical Cerebral Ratio for Anticipation of Perinatal Outcome in Appropriate for Gestational Age Foetuses at Term: A Prospective Observational Study

Obstetrics and Gynaecology Section

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ABSTRACT

Introduction: The role of amniotic fluid in embryonic development is crucial. Amniotic Fluid Volume (AFV) is maintained by physiological processes that vary with gestational age. Either oligohydramnios or polyhydramnios, a variation from the normal volume, may be related to maternal and foetal problems. Hence, considering the importance of amniotic fluid, combining Doppler with the amniotic fluid deepest vertical pocket as a ratio, for foetal wellbeing assessment might be helpful.

Aim: To study the role of Amniotic Fluid to Umbilical Cerebral Ratio (AUCR) in prediction of perinatal outcome in Appropriate for Gestational Age (AGA) foetuses at term.

Materials and Methods: A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, King George's Medical University, Lucknow, Uttar Pradesh, India from May 2021 to May 2022. Foetal Doppler ultrasound examinations, which included Umbilical Artery (UA) Doppler (systolic diastolic ratio (S/D), Pulsatility Index (PI), Resistive Index (RI)), and Middle Cerebral Artery (MCA) Doppler (S/D, PI, RI). AUCR was calculated as the ratio of Single Deepest Pocket (SDP) to Umbilical Cerebral Ratio (UCR= UAPI/MCAPI- UA PI/MC PI). Beyond this Cerebroplacental Ratio (CPR=MCAPI/UAPI- MC PI/UA PI was done. Caesarean Delivery (CD) and Operative Vaginal Delivery (OVD) due to foetal distress had been collectively termed as "OI due to foetal distress". Also, Apgar scores and neonatal unit admissions were noted.

Results: Total 112 term AGA pregnancies were followed in the present study. The age range was 18–40 years with a mean age of 26.34 years and the mean Body Mass Index (BMI) was 24.88 kg/m^2. Out of 112 term pregnancies, 56 foetuses had foetal distress, of which five had Operative Vaginal Delivery (OVD) by outlet forceps and 51 patients had Lower Segment Caesarean Section (LSCS). Ten newborns needed Neonatal Intensive Care Unit (NICU) a admission. For predicting operative intervention (adverse perinatal outcome), the Cerebroplacental Ratio (CPR) demonstrated the highest diagnostic accuracy with an AUC of 0.801 (p-value<0.001), followed by MCA PI (AUC 0.781) and AUCR (AUC 0.72).

Conclusion: Inclusion of amniotic fluid in the ratio in the form of AUCR has moderate predictive ability for the prediction of poor outcome in AGA foetuses.

Keywords: Amniotic fluid, Amniotic umbilical cerebral ratio, Cerebroplacental ratio, Deepest vertical pocket, Middle cerebral artery, Umbilical cerebral ratio

INTRODUCTION

Foetal Dopplers can pick up AGA foetuses complicated by uteroplacental insufficiency. Recent studies have shown that a CPR {CPR (MCAPI/UA PI)} less than one in near-term AGA pregnancies may warrant some obstetric interventions [1-5]. The role of amniotic fluid in embryonic development is crucial. AFV is maintained by physiological processes that vary with gestational age [6]. Either oligohydramnios or polyhydramnios, a variation from the normal volume, may be related to maternal and foetal problems. Perinatal morbidity is increased in the presence of extreme deviations in liquor volume [7]. Along with Doppler studies, the incorporation of AFV in monitoring AGA pregnancies, as an amniotic foetoplacental ratio, may be more helpful in detecting subtle hypoxia. Combining Doppler values and amniotic fluid in a ratio form is new and studied in present study. The present study investigated the role of amniotic fluid in the UCR for predicting poor perinatal outcomes in foetuses at term.

MATERIALS AND METHODS

This was a prospective observational study conducted in the Department of Obstetrics and Gynaecology, King George's Medical University, Lucknow, Uttar Pradesh, India from May 2021 to May 2022, after getting approval of the Institutional Ethics committee, Research Cell, (ECR/262/Inst/UP/2013/RR-19, 402/Ethics/2021). Consecutive sampling was done.

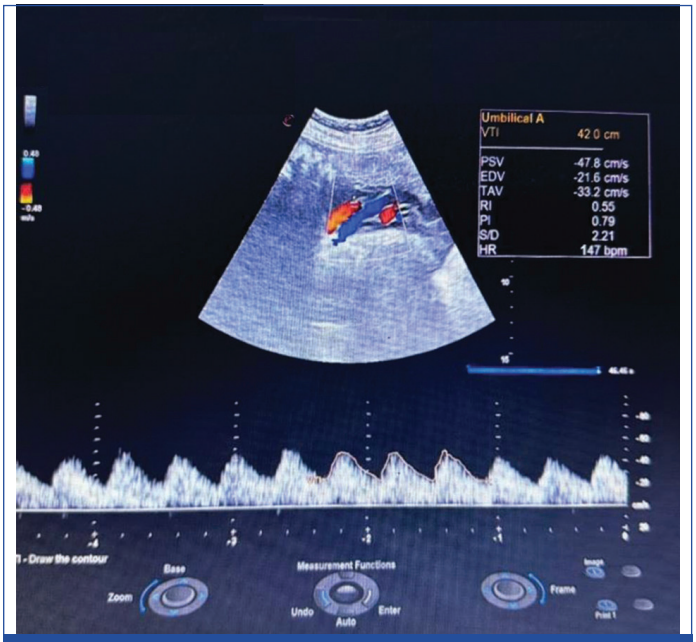
Inclusion criteria: Singleton AGA pregnant patients at term who gave consent were included in the study.

Exclusion criteria: Women who had opted for elective caesarean section, the ones who had premature rupture of membranes, multiple pregnancy and patients who did not give consent were excluded from the study.

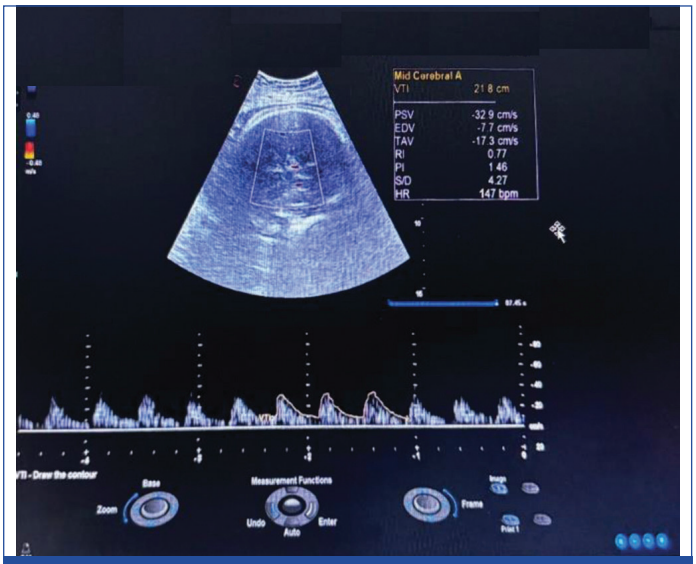
Study Procedure

For all enrolled women ultrasound examination was performed with a USG machine, Toshiba and 3-7 MHz transabdominal curvilinear transducer was used. Gestational age derived from the last menstrual period was confirmed by a first-trimester ultrasound. Doppler ultrasound examinations were done for patients included in the study within one week of delivery. Doppler ultrasound was done using a standardised protocol by a single person who is a trained operator and a foetal medicine specialist. MCA nearer to the probe was identified. MCA Doppler parameters had been performed at an angle of insonation of 0 degree. Spectral trace was obtained 2-3 mm after its origin and a sample volume of 4 mm was chosen. Pulsatility index and resistive index were measured over three consecutive cardiac cycle. For UA Doppler, the free loop of umbilical cord was targeted [Table/Fig-1], [Table/Fig-2]. MCA PI/UA PI was written as CPR and the reverse of it that is UAPI/MCA PI was documented as UCR. For the estimation of AFV, the single deepest vertical pocket was considered.

The ratio of SDP and UCR was taken as AUCR. {SDP/ (UAPI/ MCA PI)} labour was managed as per hospital protocols, intrapartum and neonatal outcomes were recorded. Delivery outcomes were noted as vaginal or operative delivery.



[Table/Fig-1]: Umbilical Artery (UA) Doppler.



[Table/Fig-2]: Middle Cerebral Artery (MCA) Doppler.

The deliveries done by operative vaginal method or by caesarean method were clubbed as Operative Interventions (OI). Diagnosis of foetal distress had been based on Cardiotocography (CTG) abnormalities, the presence of meconium-stained liquor. The 5-min Apgar score, UA pH<7.1, and need for admission to the neonatal unit were recorded.

STATISTICAL ANALYSIS

Normality of data was checked by Shapiro–Wilk test. The data were expressed as mean and Standard Deviation (SD) or median, range, and percentage as appropriate. All the categorical data were compared using the Chi-square test. Continuous variables in two groups were compared by t-test. The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) 30.0 version (IBM Corp., Armonk, NY) Windows software. The p-value of <0.05 was considered significant.

RESULTS

Total 112 term AGA pregnancies were followed in the present study. All 112 patients were admitted in the hospital and were followed for delivery and foetal outcome, and no dropouts occurred. The age range age was (18-40 years) with a mean age of 26.34 years and the mean BMI was 24.88 kg/m^2 [Table/Fig-3].

Out of 112 pregnancies, 62 (55.3%) patients had composite adverse perinatal outcomes. Out of 112 term pregnancies, 56 foetuses had foetal distress, of which five had OVD by outlet forceps and 51 patients had LSCS. Ten newborns needed NICU admission [Table/Fig-4].

The p-value of MCA PI, CPR and AUCR was found statistically significant. However, for NICU admission no significant value is obtained [Table/Fig-5].

Parameters	Range	Mean±SD
Age (years)	18-40	26.34±3.2
BMI (kg/m^2)	18.73-34.67	24.88±4.8
		n (%)
Parity (n %)	Primipara	89 (79.5)
	Multipara	23 (20.5)
Gestational age at the time of Doppler (weeks) (n %)	36-37	2 (1.8)
	37-38	38 (33.9)
	38-39	33 (29.5)
	39-40	39 (34.8)
Gestational age at the time of delivery (weeks) (n %)	37-38	40 (35.7)
	38-39	33 (29.5)
	39-40	39 (34.8)

[Table/Fig-3]: Demographic characteristics of the study population.

S. No.	Outcomes	N=62	N	%
1.	Operative Interventions due to foetal distress	Operative Vaginal Delivery (OVD)	5	8.06
		Caesarean section	51	82.25
2.	Poor perinatal outcome			
2a.	NICU admission	-	10	16.12
2b.	APGAR score at 5 min	<7	4	6.4
2c.	pH	<7.10	2	3.2

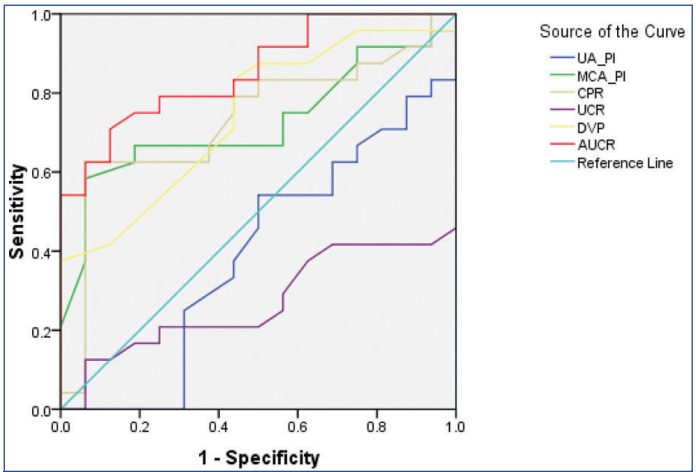
[Table/Fig-4]: Distribution of operative intervention due to foetal distress and perinatal outcome.

AGA		Cut-off	Sensitivity	Specificity	CI (95%)		Area	p-value
					Lower	Upper		
OI	UA PI	0.91	54.0	40.3	0.282	0.497	0.39	0.064
	MCA PI	1.50	58.0	52.0	0.688	0.873	0.781	<0.001
	CPR	1.27	76.0	62.9	0.709	0.894	0.801	<0.001
	UCR	0.78	74.0	66.1	0.109	0.294	0.202	0.056
	SDP	2.17	64.0	40.3	0.397	0.614	0.505	0.921
	AUCR	3.25	68.0	64.5	0.621	0.819	0.72	<0.001
NICU	UA PI	0.91	54.0	28.6	0.218	0.619	0.419	0.488
	MCA PI	1.50	58.0	71.4	0.460	0.829	0.644	0.22
	CPR	1.27	76.0	57.1	0.461	0.873	0.667	0.155
	UCR	0.78	73.9	57.1	0.124	0.541	0.333	0.155
	SDP	2.17	64.0	42.9	0.236	0.724	0.48	0.865
	AUCR	3.25	68.0	42.9	0.396	0.781	0.589	0.451

[Table/Fig-5]: Univariate logistic regression analysis for prediction of adverse perinatal outcome in AGA pregnancy (n=62).

The ROC curve plots sensitivity against 1-specificity at different cut-off values and is used to assess the diagnostic performance of a test. The area under the curve (AUC) represents the overall discriminative ability, with values closer to 1 indicating better discrimination. In the present study, CPR showed the highest AUC (0.801), followed by MCA PI (0.781) and AUCR (0.720). [Table/

Fig-6] shows the diagnostic performance of various parameters for operative interventions.



[Table/Fig-6]: ROC curve for operative interventions.

DISCUSSION

Doppler can detect subclinical placental damage in term AGA pregnancies [8]. Intrapartum time is critical because placental circulation is the most challenging, and it is extremely difficult to classify patients who would require operative delivery for foetal distress and who will have a negative perinatal outcome.

In the present study, CPR was found to have a statistically significant role in the prediction of operative interventions. Mecke L et al., also have shown that the lower the CPRs were, the higher the chances of having foetal distress were noted [9]. If CPR remained more than the 90th centile of corresponding gestational age, it did not require operative delivery. In Zohav E et al., median value of CPR at term was in the range of 1.65-1.81 [10]. In AGA foetuses for prediction of operative intervention (both OVD and CD due to foetal distress), no ratio was found to be superior to another one. For the prediction of NICU admission, again, both the ratios had similar sensitivity and specificity.

Coenen H et al., also proposed that there was no difference in predictive accuracy of UCR And CPR [11]. Stumpfe FM et al., explained that reversal of CPR to UCR does not improve the prediction of adverse perinatal outcomes [12]. In a study by Leavitt K et al., for a fixed false positive rate of 10%, the detection rates for adverse neonatal outcomes were 40% using either CPR or UCR [13]. Due to a lack of optimum predictive capability, the inclusion of amniotic fluid in Doppler was tried in the present study. If AUCR can be used for better guidance in AGA, was the aim of the study. In the presence of placental insufficiency, redistribution of blood flow occurs, and in need of increasing the blood flow to the brain, flow to kidney decreases, which results in decreased urine production and decreased liquor. Kehl S et al., and Rosati P et al., found poor perinatal outcomes in pregnancies complicated by decreased liquor [14,15]. In the present study, when AUCR was assessed for the prediction of OI in AGA foetuses, area under the curve was 0.72, and p-value was <0.001 which suggests moderate predictive ability of AUCR in poor perinatal outcome in AGA foetuses. Stumpfe FM et al., have evaluated a novel marker in the form of AUCR and showed it to have the best performance for the prediction of poor perinatal outcomes in FGR pregnancies [16]. Similarly, Besimoglu B et al., study had the highest area under the curve for AUCR in FGR pregnancies to predict poor perinatal outcome, and it was (0.882; p-value<0.001) [17]. Seyhanli Z et al., also studied AUCR in early versus late onset FGR foetuses and found that AUCR is a strong marker for the prediction of poor perinatal outcome in late onset FGR but not in early onset FGR [18].

Limitation(s)

Small sample size and single centre study was the limitation of the study. Potential confounders such as maternal age, BMI, parity, and gestational age were not adjusted for. Multicentric analysis with large sample size would be required for accuracy and precision.

CONCLUSION(S)

Taking into account the amniotic fluid single deepest vertical pocket, along with foetal Doppler (AUCR) is helpful in the prediction of poor perinatal outcome in appropriate gestational age foetuses.

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