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Comparative Study of Uterine Artery Dopplerbetween Small for Gestational Age and Appropriate For Gestational Age Foetus.

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Abstracts*: This was a comparative study of Uterine artery Doppler velocimetry during pregnancy between small for gestational age and appropriate for gestational age. The study population consisted of 100 pregnant women, 35 cases with small for gestational age (SGA) and another 65 cases with clinically appropriate for gestational age (AGA). Hypertension were present in 19 of 35 SGA foetuses and in 5 of 65 AGA foetuses. Uterine artery mean PI (1.5 vs.1), RI (.7 vs.0.5) and S/D (2.9 vs.2.4) ratio were all significantly raised in SGA foetuses in comparison to AGA foetuses in this study indicating raised impedance to blood flow. Uterine artery notching was found in 11 cases and all of them had SGA babies. In high risk women uterine artery Doppler waveform analysis gives a better prediction for SGA foetuses than clinical assessment alone.*
Keywords*: uterine artery, Doppler study, SGA*

I. Introduction

Flow pattern of uterine artery reflects the evidence of uteroplacental circulation. Uterine arteries branch into arcuate arteries leading to spiral arteries within the myometrium. During the later part of first trimester extra villous trophoblast invade the spiral arteries converting these vessels from high resistance to low resistance vessels and also produce vasodilator peptides acting locally in deciduas and myometrium. Uterine blood flow in non-pregnant women is 50 ml per minute which increases to over 700 ml per minute in third trimester of pregnancy. Doppler waveform of uterine artery shows low peak flow velocity and disappearance of diastolic notch by 18-22 weeks in normal pregnancies.Pre eclampsia, IUGR and other high risk conditionsare associated with a rise in vascular resistance in uterine artries which can be estimated by pulsatility index, resistance index, systolic/diastolic ratio and persistence of uterine diastolic notch.

II. Materials and Method

The study population consisted of 100 pregnant women, 35 cases with small for gestational age (SGA) and another 65 cases with clinically appropriate for gestational age (AGA). The inclusion criteria were singleton live pregnancies of gestational age beyond 28 weeks with known date of last menstrual period or early ultrasound report to calculate LMP. Exclusion criteria were intrauterine fetal death and foetuses with congenital anomalies. Consent and detailed history were taken. All the patients were subjected to ultrasound examination with ultrasonography machine having facility of colour Doppler imaging. Carrier frequency of 3.5 MHz and 7.5 MHz were used. Foetal biometry were taken as a routine. Pulse wave Doppler ultrasound examination were then performed. Uterine artery (Ut A) was studied by first identifying the placental site. If the placenta was unilateral, the uterine artery of that side was studied. If the placenta was central, bilateral uterine arteries were studied and the mean were taken. Sampling point for the uterine artery was the point where it crossed the external iliac artery near the cervicouterine junction.Parameters observed were pulsatility Index (PI), resistance index (RI), systolic/diastolic (S/D) ratio andearly diastolic notching of the uterine artery. Uterine artery PI & RI values were based on chart given by Merz E in 2005[1]. 95th percentile was taken as the cutoff point. Statistical analysis used is descriptive statistics (mean, percentage), chi square and fisher's exact test and t test.

III. Observation

Of 100 cases included in the study. 35 were small for gestational age (SGA)and remaining were appropriate for gestational age (AGA). Hypertension were present in 19 of 35 SGA foetuses and in 5 of 65 AGA foetuses.

Table1. 't –test' Showing mean difference in Uterine artery PI among the two groups

Outcome	Uterine artery PIMean(SD)	Mean difference	T	P-value
SGA	1.536(0.57)	0.5306	5.699	0.0000
AGA	1.0066(0.35)			

The mean (SD) of Ut A PI were higher in SGA babies than AGA babies and the difference was statistically significant.

Table2. 't –test' Showing mean difference in Uterine artery RI among the two groups

Outcome	Uterine artery RIMean(SD)	Mean difference	t	P-value
SGA	0.723(0.16)	0.1339	3.918	0.000
AGA	0.589(0.15)			

The mean (SD) of Ut A RI were higher in SGA babies than AGA babies and the difference was statistically significant.

Table3. 't –test' Showing mean difference in Uterine artery S/D among the two groups

Outcome	Uterine artery S/DMean(SD)	Mean difference	t	P-value
SGA	2.95(1.004)	0.5114	3.278	0.001
AGA	2.44(0.558)			

Mean S/D ratio of uterine Artery was higher in SGA babies (2.95) compared to AGA babies (2.4) & the mean difference was statistically significant.

Table4. Comparison of Gestational outcome by Uterine artery S/D (N=100)

Uterine artery S/D	Outcome, N (%)		P-value
	SGA	AGA	0.000
≤ 2.6	14 (19.7%)	57 (80.3%)	
> 2.6	21 (72.4%)	8 (27.6%)	

Abnormal S/D ratio of >2.6 in uterine artery were significantly more in SGA foetuses as seen in this table.

Table 5. Sensitivity, Specificity, PPV & NPV of Uterine artery SD Ratio in detecting SGA.

Ut A S/D	SGA	AGA	TOTAL
>2.6	2	8	2 9
≤ 2.6	1	5	7 1
TOTAL	3	6	1 0 0

Sensitivity were 60%, specificity 87.6%, positive predictive value were 72.4% and negative predictive value were 80.2%. Uterine artery diastolic notching was seen in 11 SGA foetuses, 8 of them had unilateral notching and 3 bilateral notching. And 8 of them had hypertension.

IV. Discussion

David et al[2] in 1998 remarked that ultrasound biometry is the gold standard for assessment of foetal size.The failure of a foetus to attain its expected growth may result from different complications but the final common pathway most often encountered is via uteroplacental insufficiency. In this series among the various risk factors hypertension was a very significant risk factor for small for gestational age in fetuses which was in agreement with other workers (Thaler et al 1992[3], K Harrington e al 1999[4] and Coleman et al 2000[5]). Uterine arteries branch into arcuate arteries leading to spiral arteries within the myometrium. During the later part of first trimester trophoblast invade the spiral arteries converting these vessels from high resistance to low resistance vessels and also produce vasodilator peptides acting locally in deciduas and myometrium. In SGA there is lack of trophoblastic invasion resulting in uteroplacental insufficiency. The onset of growth retardation can be predicted by Doppler indices of the uterine artery. But In 2005, Nagtegaal MJ et al[6] stated that uterine Doppler is not particularly useful in the management of patients with a risk to develop uteroplacental insufficiency.

Uterine artery mean PI (1.5 vs.1), RI (.7 vs.0.5) and S/D (2.9 vs.2.4) ratio were all significantly raised in SGA foetuses in comparison to AGA foetuses in this study indicating raised impedance to blood flow. In 1999 Bhushan and Shefeek [7]also noted the same trend with significant statistical difference (PI 1.3 vs 0.6, RI 0.6 vs 0.4, S/D 2.9 vs 1.8). In 2000, Coleman MA et al [5]defined Ut A RI of > 0.58 as abnormal and an RI of ≥ 0.7 was defined as very abnormal. They concluded that in high risk women, uterine artery Doppler waveform analysis was better than clinical risk assessment in the prediction of pre-eclampsia and SGA babies.

In this series abnormal S/D ratio of >2.6 in uterine artery were significantly more in SGA foetuses. In 1986 Fleicher et al[8] noted that if the S/D ratio of uterine artery exceeds 2.6 the situation is predictive of adverse perinatal outcome. Here S/D ratio of >2.6 had a sensitivity of 60%, specificity 87.6%, PPV 72.4% and NPV

80.2%. Bhushan and Shefeek [7]in 1999 reported that sensitivity, specificity, PPV and NPV of uterine artery S/D ratio for detecting SGA babies are 67%, 90.3%, 80% and 82.6%.

In this study uterine artery notching were found in 11 cases and all of them had SGA babies. 8 of them were associated with hypertension. Thaler et al[3] in 1992, Bower et al[9] in 1993, Park et al[10] in 1996 and Axt Fliedner R[11] in 2004 also noted higher association of uterine notching with hypertension.

V. Conclusion

The failure of a foetus to attain its expected growth may result from different fetomaternal complications. Common causes of small for gestational age foetuses are preeclmpsia, eclampsia, gestational hypertension,diabetes, smoking and medical condition that increases the mother's chances of blood clots etc and the final common pathway most often encountered is via uteroplacental insufficiency. Flow pattern of uterine artery reflects the evidence of uteroplacental vascular ischemia. The uteroplacental insufficiency seen with IUGR is associated with a rise in vascular resistance in uterine arteries which can be estimated by raised pulsatility index, resistance index, systolic/diastolic ratio in these arteries and persistence of uterine artery diastolic notch. In this series SGA babies were significantly associated with raised PI, RI and S/D ratio in uterine and persistence of notch in uterine artery.

In high risk women uterine artery Doppler waveform analysis gives a better prediction for SGA foetuses than clinical assessment alone.

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