

Correlation between Placental Location and Uterine Artery Flow Waveforms in Uncomplicated Pregnancies.

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Abstract: The objective of the study was to understand the changes in uterine artery blood flow in normal pregnancies and also their correlation with factors like placental location. In this prospective study, a total of 100 random uncomplicated singleton pregnant women who attended antenatal clinic in our hospital and falling under 26-32 weeks of gestation by Ultrasound were included. Colour Doppler study of the uterine arteries was also performed on each patient. The location of placenta was determined by Ultrasound and categorized as 'Central', 'Lateral' and 'Lateral crossing Midline'. The mean S/D ratios of bilateral uterine arteries were then recorded by Doppler study. Thereafter the difference between the two S/D ratios calculated and analysed. Percentages and Chi square test to calculate level of significance. Results: Out of 100 women, 28 had lateral placenta, 39 had central and 33 had lateral crossing midline placenta. In all Lateral and Lateral crossing midline subjects, the ipsilateral S/D was lower than contralateral one. Also, in Lateral group the difference turned out to be statistically significant and central group, not significant.

Conclusion: The study demonstrated a significant relationship between placental location and uterine artery S/D ratio in uncomplicated pregnancies.

INTRODUCTION

The changes that take place in the uterine artery blood flow in pregnancy are of utmost importance. Various studies have been undertaken to assess the effect of various factors on the uterine blood flow in normal and abnormal pregnancies¹. In our study, we tried to correlate it with placental location. Several methods have been used to document placental location, including manual exploration of uterus, soft tissue x-ray films and isotopic placentography. Nowadays, ultrasound has proved to be the safest, easiest and the most accurate method for assessing placental location. Also, Doppler Ultrasound provides a non invasive method for the study of uteroplacental circulation and fetal hemodynamics.

The ratio of the systolic peak velocity and end-diastolic velocity (S/D) has been used as an expression of uterine vascular resistance. Though there are other indices used like Resistive index, yet uterine artery S/D is a relatively simple indicator to calculate and express vascular resistance.

MATERIALS AND METHODS

In this prospective study, a total of 100 random uncomplicated singleton pregnant patients between 26-32 weeks of gestation, attending the antenatal clinic of our hospital were included. All patients were examined once during their pregnancy. Gestational age was determined by ultrasound. 26 weeks was set as the lower limit because the trophoblastic invasion of spiral arteries and loss of diastolic notch is well established by then. Also, beyond 32 weeks the difference between the two S/D ratios tends to decrease. Patients with chronic hypertension, twin gestation, uterine anomalies, preeclampsia/ eclampsia were excluded.

The equipment used was convex probe at 3.5 MHz of GE Logiq 5 Pro ultrasound machine. The location of placenta was determined by real time ultrasound by placing the convex probe in the midline to acquire an axial section. The placenta was classified irrespective of its anteroposterior and fundal position. It was classified as 'central (C)' when it was equally distributed on right and left sides. It was classified as 'lateral crossing midline (LCM)' when majority of placental tissue was on one side. The third group comprised of placentas that were purely 'lateral (L)'. Placental location was evaluated without knowledge of the systolic/ diastolic ratio values to avoid bias.

The Doppler flow velocity waveforms were obtained with the mother lying comfortably in a slight left lateral tilt to minimize the risk of developing supine hypotension due to caval compression. The spectral Doppler waveform was obtained by placing the Doppler transducer 2-3

cm medial to the anterior superior iliac spine. This landmark permitted regional consistency and reproducibility of flow velocity waveforms. Here, the uterine artery is seen to cross the external iliac artery, just after its origin from the internal iliac artery and this point was taken as the sampling point [Fig 1]. Three measurements of S/D ratio were taken on each side [Fig 2]. The average ratio was then calculated from the three values and said to be the mean uterine S/D of each side. Numerical value thus calculated was rounded off to the first decimal place. Thereafter, the difference between the two S/D ratios (right and left) was calculated by simple subtraction if lower value from the higher, in each patient.



Figure 1: Localization of Uterine Artery. Artery seen crossing the of Uterine artery between 26-32 ipsilateral external iliac artery weeks.

RESULTS

It was observed that of the 100 subjects included in the study, 28 had lateral placentas(L), 39 had centrally located placentas(C) and 33 had placentas on one side but crossing midline (LCM).

The differences obtained in S/D ratios were categorized under three groups as shown in the Table 4. To make the difference interval groups uniform, 0 - <0.2, 0.2 - <0.4 and 0.4 - <0.6 were used and 96 pregnancies fell under this(N=96). The remaining 4 subjects had difference of e" 0.6 in the right and left uterine arteries and all 4 had lateral placentas.

It was noted that in all the 28 (24 out of 96 patients and 4 extra) patients of 'lateral' placenta group, the ipsilateral S/D was lower than contralateral S/D and the difference of S/D ratios of the two sides turned out to be statistically significant.

In no patient of this group it was noted otherwise. In this group as many as 50% of the subjects had the difference of 0.4 - <0.6 in the two uterine arteries(Table-1). In group-wise distribution also, the findings are substantiated (Table-4), as only 9% of the subjects falling under 0 - <0.2 category, had lateral placentas.

It was observed that in all 33 patients having 'Lateral crossing midline' placentas (LCM) also, the side where majority of the placental tissue was situated had lower uterine artery S/D than the contralateral side. However, statistical significance of the difference could not be attained in our study. Further, the 39 patients of 'central' placenta group showed the propensity

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to have lesser difference in the two S/D ratios as compared to Lateral and Lateral crossing midline groups (Table 2,3)). This difference in the S/D ratios of two sides was not statistically significant in our study. 47.2% of subjects falling under 0.2 - <0.4 group, were seen to have central placentas (Table-4). Only 30.8% of central placenta patients fell under 0.4 - <0.6 group whereas 50% of lateral placenta patients and 42.4% of LCM patients fell under this difference group (Tables-1,2,3).

Three of the patients demonstrated diastolic notching in one side's uterine artery waveform, and all three fell under the Lateral placenta group. It was further observed that the notching occurred in the contralateral uterine artery with regard to placental location in all these three cases.

Table-1

Lateral placentas (L) (24/96) n= 24	Number	Difference grp	Percentage
	2/24	0 - <0.2	8.3 %
	10/24	0.2 - <0.4	41.7 %
	12/24	0.4 - <0.6	50 %

Table-2

Central placentas (C) (39/96) n=39	Number	Difference grp	Percentage
	10/39	0 - <0.2	25.7 %
	17/39	0.2 - <0.4	43.5 %
	12/39	0.4 - <0.6	30.8 %

Table-3

Lateral Crossing Midline (LCM) placentas (33/96) n=33	Number	Difference grp	Percentage
	10/33	0 - <0.2	30.3 %
	9/33	0.2 - <0.4	27.3 %
	14/33	0.4 - <0.6	42.4 %

Statistical analysis was based on percentages and Chi-Square formula to calculate level of significance.

Table-4

Statistical Analysis								
	0 TO < 0.2		0.2 - <0.4		0.4 - <0.6		Chi-Square Test Value	Result*
L	2/22	9 %	10/36	27.8 %	12/38	31.6 %	7	Significant
C	10/22	45.5 %	17/36	47.2 %	12/38	31.6 %	2.62	Not Significant
LCM	10/22	45.5 %	9/36	25 %	14/38	36.8 %	1.27	Not Significant

DISCUSSION

The main branch of each uterine artery enters the uterus just above the cervix and ascends along the lateral part of its wall. It gives rise to arcuate arteries that derive their name from the arching pattern in the uterus. The arcuate arteries give off multiple branches called radial arteries into the outer third of the myometrium, deriving their name due to their penetrating the uterine myometrium at right angles². As the radial arteries approach the inner myometrium they become spiral arteries. In the non-pregnant state, the uterine artery is a high resistance vessel.

Physiological modification of spiral arteries is required to permit the increase in uterine blood flow which is necessary to meet the requirements of the fetus and the placenta. This modification is termed as 'Physiological change' which takes place in 2 stages- the first wave of trophoblastic invasion converts the decidual segments of the spiral arteries in the first trimester (completed by 13 weeks) and the second wave converts the myometrial segments in the second

trimester (completed by 26 weeks)². As a result of physiological change, the diameter of the spiral arteries increases, thus reducing impedance to flow and optimizing fetomaternal exchange in the intervillous space^{3,4}. Thus there is an increase in the diastolic flow and consequent fall in S/D ratios. Also, the early diastolic notch seen normally up to 26 weeks of gestation, disappears thereafter in normal pregnancies^{5,6}. It has been shown in humans that both uterine arteries along with their significant number of branches supply the corresponding side of the uterus⁷.

Our study demonstrated a significant relationship between placental location and uterine artery resistance expressed by the systolic/ diastolic ratio of the uterine artery flow velocity waveforms in normal pregnancies. When the placenta was lateral or lateral crossing midline, which comprised 61% of our study population, the uterine artery closer to the placenta had lower resistance than the one opposite to it. Also, when the difference of the S/D ratios of the two sides were compared 50% of lateral placenta patients fell under 0.4 - <0.6 difference group while only 30.8% of central placenta patients fell under 0.4 - <0.6 group. The difference in S/D ratios in the lateral group was found to be statistically significant. However, in our study the statistical significance of the difference of S/D ratios of two sides could not be established in Lateral crossing midline placenta group. There is a need for studies with larger sample sizes to establish the same.

On review of literature, it was found that in a prospective study conducted by Kofinas AD et al, they also found that right and left uterine artery flow velocity waveforms demonstrated significantly different S/D ratios when the placenta was found unilaterally. When the placenta was centrally located, the difference between the right and left uterine arteries was not statistically significant⁸. However, in contrast to our study, they classified the placentas in two groups and not three. Nevertheless, the findings in our study corroborated with theirs. Campbell et al used duplex-pulsed Doppler to evaluate flow velocity waveforms and found that the vessels on the placental side have a lower pulsatility index⁹. However, it is not clear from their report whether the flow velocity waveforms were obtained from the right or left side or simply away from the placenta. In addition, their description indicated the measurements may have been obtained from the parametrial area anywhere between the cervix and cornu of the uterus. This is important with regard to comparisons because in our study and the one done by Kofinas et al, it was found that even on the placental side the S/D ratio increased as the distance from the placenta increased.

Further, our study also showed that it is not possible to predict the site of placental location on basis of uterine artery waveforms. This was evident by the fact that in 0.4-<0.6 group, the placental location was almost equally distributed- 31.6% lateral, 31.6 % central and 36.8% lateral crossing midline.

However, once one knows the site of placentation, one gets an idea as to what kind of uterine artery blood flow to expect.

CONCLUSION

Our study demonstrated a significant relationship between placental location and uterine artery systolic/ diastolic ratio in uncomplicated pregnancies.

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LITERATURE REVIEW

A negative Urinalysis rules out Catheter-Associated Urinary Tract Infection in Trauma Patients in the Intensive Care Unit.

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Urinary tract infection (UTI) in trauma patients is associated with increased mortality. Whether the urinalysis (UA) is an adequate test for a urinary source of fever in the ICU trauma patient has not been demonstrated. We hypothesized that the UA is a valuable screen for UTI in the febrile, critically ill trauma patient. All trauma ICU patients in our surgical ICU who had a fever (temperature >38.0°C), urinary catheter, UA, and a urine culture between January 1, 2011 and December 13, 2011 were reviewed. A positive UA was defined as positive leukocyte esterase, positive nitrite, WBC > 10/high power field, or presence of bacteria. A positive urine culture was defined as growth of e¹⁰(5) colony forming units (cfu) of an organism irrespective of the UA result or e¹⁰(3) cfu in the setting of a positive UA. A UTI was defined as positive urine culture without an alternative cause of the fever. There were 232 UAs from 112 patients that met criteria. The majority (75%) of patients were men; the mean age was 40 (±16) years. Of the 232 UAs, 90 (38.7%) were positive. There were 14 UTIs. The sensitivity, specificity, positive predictive value, and negative predictive value of the UA for UTI were 100%, 65.1%, 15.5%, and 100%, respectively. **CONCLUSIONS:** A negative UA reliably excludes a catheter-associated UTI in the febrile, trauma ICU patient with a 100% negative predictive value, and it can rapidly direct the clinician toward more likely sources of fever and reduce unnecessary urine cultures.