# RELATIONSHIP BETWEEN UMBILICAL VEIN DIAMETER (UVD) AND GROWTH PARAMETERS IN NIGERIAN FOETUSES

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#### ABSTRACT

The intrahepatic diameter of the umbilical vein of 350 normal and singleton fetuses were measured sonographically to establish the relationship between umbilical vein diameter (UVD) and fetal growth parameters.

Foetuses from 17 weeks to 40 weeks were evaluated sonographically in mothers who had no history of chronic illness or abnormal liquor volumes. The least squares method was used to fit mean UVD values against G.A. Pearson Moment Correlation analysis was also performed between the mean UVD and the other established growth parameters (BPD and AC) obtained concurrently.

There was a steady increase in the foetal UVD with gestational age which is expressed by the equation. GA = 2.36 + 4.84 UVD. The fastest growth rate of the UVD occurred in the last 10 weeks of gestation with a maximum mean value of 9.85 + 0.71mm. The UVD correlated strongly and positively with both BPD and AC.

# **ABSTRAIT**

Le diamètre intrahépatique de la veine ombilicale de 350 foetus normaux et de singleton ont été mesurés sonographically pour établir le rapport entre le diamètre veing ombilical \* UVD) et paramètres foetaux de croissance.

Des foetus de 17 semaines à 40 semaines ont été évalués sonographically dans les mères qui n'ont eu aucune histoire de maladie chronique ou de volumes anormaux de boisson alcoolisée. La méthode des moindres carrés a été employée pour adapter des valeurs moyennes d'UVD contre G.A. L'analyse de corrélation de moment de Pearson a été également exécutée entre l'UVD moyen et les autres paramètres établis de croissance (baril par jour et C.A.) obtenus concurremment.

Il y avait une augmentation régulière de l'UVD foetal avec l'âge de gestational qui est exprimé par l'équation. GA = 2.36 + 4.84 UVD. La vitesse de croissance la plus rapide de l'UVD s'est produite en 10 dernières semaines de la gestation avec une valeur moyenne maximum de 9.85 + de 0.71mm. L'UVD corrélé fortement et franchement avec le baril par jour et le C.A..

# INTRODUCTION:

The umbilical vein diameter (UVD) has been studied in relation to rhesus isoimunization, umbilical blood flow and pathologies of the cord <sup>1.2.3</sup>. Umbilical varix which is a focal dilatation of the umbilical vein has been associated with unexplained high mortality rate in utero and thrombosis within the dilatation has led to foetal death and other

complications including hydrops foetalis.<sup>4</sup>

Knowledge of population specific normal dimensions of the UVD at various gestational ages would facilitate diagnosis of any haemodynamic compromise to the foetal blood supply and its associated effect on foetal growth.

#### MATERIALS AND METHODS

This study was conducted at the Radiology Department of the University of Nigeria Teaching Hospital (UNTH), Enugu. Patients referred for sonography from the ante-natal clinics of the hospital were enlisted. Only subjects who had history of regular menstrual cycle, known last menstrual period (LMP), singleton and uncomplicated pregnancies were included. (10)

During the scan, only those foetuses whose gestational evaluation met with the criteria of a normal biophysical profile were eventually included.

Out of 500 subjects initially enlisted only 350 met the selection criteria. The UVD was measured ultrasonographically using a real-time sector scanner (Sonoline SL 2) with a transducer frequency of 3.5 MHZ and a caliper calibrated for an assumed ultrasound velocity of 1540ms<sup>-1</sup> in soft tissue.

To measure the UVD, the foetus was scanned in the longitudinal plane until the foetal aorta was seen. The transducer was then rotated through 90° at the level of the lower foetal ribs. By adjusting the transducer, a section was obtained just above the kidney where the umbilical vein appeared as a perfect circle. The intrahepatic diameter was measured prior to the junction of the umbilical vein and the portal sinus¹

Measurements were taken from outer to inner margins of the vein at the

widest transverse and sagittal diameters as shown in Fig. 1. Average values were calculated after at least five measurements and the mean obtained for each gestational age. Two observers carried out the measurements and the inter observer variation coefficients calculated. The biparietal diameter (BPD) and the abdominal circumference (AC) were also measured for each foetus and the mean for each gestational age calculated. A least mean square method was used to fit UVD against GA and a linear regression equation obtained. Comparison was made between UVD in foetal liver versus BPD and AC.

'Pearson Moment Correlation' was performed between GA and the anthropometric parameters (BPD, AC and UVD) and between UVD, BPD and AC. Only UVD of fetuses from 17 weeks of gestational age (calculated from the last menstrual period) were measured because below this, GA values are unreliable and the UVD is not clearly delineated on the scan.

# RESULTS

Table 1 shows the mean UVD in foetal liver and the corresponding menstrual ages at two standard deviation (2 SD). The mean value of the UVD from 17 weeks to 40 weeks was 5.70mm. A steady increase was noticed in the UVD from 17 weeks to 40 weeks. The growth rate for the 20-30 weeks and 30-40 week periods were 0.17mm and 0.34mm respectively. The mean of the maximum UVD at 40 weeks was 9.85+0.71mm. The intra observer coefficient of variation was 6.3%.

Table 2 shows the range of G.A. measured and the corresponding values of the anthropometric parameters (BPD and AC). The result of the linear regression analysis yielded the equation G.A. = 2.36 + 4.84 UVD.

The 'Pearson Moment Correlation' analysis indicated a high positive relationship between G.A. and BPD (r = 0.99), GA and UVD (r = 0.95), AC

and UVD (r = 0.93) and BPD and UVD (r = 0.94). There is also a significant relationship between UVD and BPD, and between UVD and AC (r = 0.93 and 0.93 respectively)

### **DISCUSSION**

In foetal circulation the umbilical vein (UV) carries blood charged with nutritive material and oxygen from the placenta to the foetal liver. The UV thus contributes significantly to the metabolism of the foetus and any haemodynamic compromise may affect the foetus adversely.

It is for these reasons that the umbilical vein has been the subject of much investigation. For example, the umbilical vein (UV), flow rate<sup>5,6</sup>, UV pulsation and absolute umbilical blood flow rate have all been investigated.<sup>6</sup> The relationship between UV blood flow and foetal growth parameters has also been assessed and Babera et al<sup>3</sup> noted a strong correlation between absolute UV blood flow and foetal head and abdominal circumference (AC).

The umbilical vein diameter (UVD) is an estimate of the size of the UV and its value is important in the blood supply to the foetus and consequently will affect foetal growth. A direct relationship has already been established between the UVD and the mean velocity and absolute UV blood flow by Babera et al<sup>3</sup>

From this study, the UVD increased linearly throughout gestation from the  $17^{\text{th}}$  week of pregnancy to the  $40^{\text{th}}$  week with the fastest growth occurring between the last 10 weeks ( $30^{\text{th}}$   $40^{\text{th}}$  week) as shown in Table I. This relationship is expressed mathematically by this regression equation. GA = 2.36 + 4.84 UVD for normal, uncomplicated and singletion pregnancies. A strong positive correlation was also noted between UVD

and both BPD and AC.

From the regression equation normal UVD values can be calculated for various GAS and possible cause of growth retardation identified. The positive correlation between the UVD and the growth parameters also present the potential for the use of UVD in dating pregnancy. This is particularly important since the UVD has its fastest growth rate occurring in the last 10 weeks of gestation where the BPD is less reliable in dating pregnancy because its growth rate is fastest within 20-30 weeks of pregnancy<sup>6</sup>. UVD can be used therefore in late pregnancy for better accuracy in dating pregnancy and in conditions where BPD is unreliable like dolicocephaly and early foetal head engagement.

The normal UVD obtained across the gestational age can also serve as guide in establishing venous constriction and haemodynamic compromise in the absence of a Doppler instrument for measuring venous blood flow parameters. This is because venous blood flow and its pulsation have been noted to be related to the UVD values.

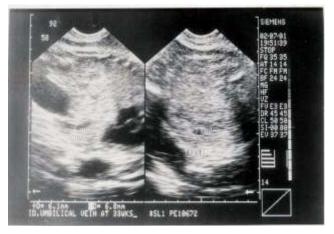
The maximum mean UVD in Caucasian population is 10.00+0.12mm<sup>7</sup> compared to 9.85+0.71mm obtained in this study. However, this difference is not statistically significant (P>0.05).

Table 1: Mean intrahepatic UVD Values and their corresponding gestational ages

Menstrual Age	No. of Measurement	Mean Values (mm)	S.D
17	11	3.18	0.14
18	9	3.51	0.16
19	10	3.56	0.20
20	14	3.67	0.35
21	14	3.75	0.17
22	13	4.05	0.09
23	18	4.42	0.05
24	12	4.54	0.56
25	17	4.72	0.24
26	11	4.91	0.63
27	10	5.09	0.35
28	9	5.17	0.06
29	12	5.32	0.19
30	13	5.44	0.20
31	23	5.56	0.33
32	15	5.67	0.24
33	18	6.04	0.42
34	19	6.15	0.08
35	21	6.43	0.06
36	21	6.74	6.63
37	20	7.08	6.54
38	12	8.10	0.46
39	10	8.12	1.28
40	10	9.85	0.71

Table 2: Measured Mean UVD, BPD and AC values matched against corresponding gestational ages.

GA	Mean UVD	Mean BPD	Mean AC
17	3.18	37.8	122
18	3.51	42.0	120
19	3.56	44.2	146
20	3.67	48.1	153.25
21	3.75	53.4	160
22	4.05	55.0	180
23	4.42	57.6	190.3
24	4.54	60.5	200.5
25	4.72	63.6	212.5
26	4.91	66.3	228
27	5.09	67.2	270
28	5.17	69.1	239
29	5.32	72.5	244.5
30	5.44	75.2	257.38
31	5.56	78.7	267.12
32	5.67	81.4	264.38
33	6.04	83.4	292
34	6.15	85.4	306.5
35	6.43	88.2	314.73
36	6.74	89.4	314.86
37	7.08	92.3	329.53
38	8.1	93.7	340.54
39	8.12	99.8	346.5
40	9.85	98	343.5



Umbilical Vein at 33wks

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