Influence of Maternal Hemoglobin and Serum Ferritin on Midpregnancy Placental Volume

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Summary:

A study of 75 antenatal patients was conducted in the department of Obstetrics & Gynaecology of M. A. M. C. & Associated L. N. Hospital to study the influence of maternal haemoglobin & serum ferritin on mid-pregnancy placental volume. It was found that mean pregnancy placental volume increased significantly as maternal hemoglobin & serum ferritin levels fell (P = 0.0012 for Hb, P < 0.0001 for serum ferritin). Mean and mid-pregnancy placental volume also increased with increase in maternal weight (P=0.0117) but it was not affected by other maternal variables like age, parity and height.

Introduction

It has been said that placenta is the most accurate record of the infant's prenatal experiences. It has long been recognized that events in early life may have a profound influence on adult physiology and disease. Recent epidemiological studies provide evidence to support this prediction and suggest that the pathological processes leading to adult ischaemic heart disease are initiated before birth.

This study was done to see the effect of maternal hemoglobin & serum ferritin levels on midpregnancy placental volume in Indian population.

Material and Methods

The study was carried out in Department of Obstetrics & Gynaecology & Deptt. of Biochemistry, Maulana Azad Medical College & L. N. Hospital, Delhi. Seventy five patients were recruited for study from antenatal clinic of L. N. Hospital, Delhi.

The selection criteria were :-

- Age 18-35 yrs.
- Any parity
- Singleton pregnancy
- Gestation period between 16-20 weeks.

Gestation period of the patients was calculated from first day of the last menstrual period provided she was sure of dates, had regular cycles and her last period was not a contraceptive pill withdrawal. If any of these criteria were not met with, her gestation was calculated from the ultrasound scan measurements by measuring fetal biparietal diameter, head circumference, femur length and abdominal circumference using composite age estimate by averaging technique (Hadlock 1990).

Patient was excluded from the study if she had:-

- Diabetes
- Syphilis
- Hypertension
- Heart disease
- Asthma
- Rh incompatibility
- Multiple Pregnancy
- Congenitally malformed fetus,

As all these conditions affect the placenta.

For all patients blood hemoglobin & serum ferritin levels were measured. Hb was measured by cynmethaemoglobin (colorimetric) method. Cut off level of Hb was taken as 11gm/dl for anaemia defined by WHO (1968).

Serum ferritin level was measured by enzyme linked immuno sorbant assay method. Ultrasound scanning was done by Phillips real time ultrasound machine using linear transducer (4 Mhz) to confirm gestational age, to exclude congenital anomalies, to see the amount of liquor and to localize placenta. Placental volume was estimated by parallel planimetric area method (Geirsson et al, 1982). Placenta was localized and linear probe moved from one end to other focussing placental section at equal distances of 2 cm and measuring area of each section till whole of the placenta was covered. It took an average of

four section scans to cover whole placenta. Placental volume was measured by using the trapzoidal law :
$V = D X (A1 + A2 + ...+ An)$.
Where V = Volume
D=distance between the scans i.e. 2 cm

If distance 'D' from the last section (An) to the other end of placenta was less than 2cm, a correction factor was calculated and An in the previous formula was replaced by 1.5 An.

Single ultrasound volume was done to correlate with patient's Hb & serum ferritin levels. Correlation of placental volume with maternal age, parity, height & weight was also done.

The relation between maternal characteristics and placental volume was examined first by univariate regression analysis; parity was examined by tabulation of means and statistical significance tested by using one way analysis of variance. The distribution of ferritin was positively skewed, so for statistical analysis, these values were transformed to a symmetrical distribution by taking square roots. Multiple regression analysis was done to see the simultaneous relation between maternal variables and placental volume for recognizing non-linear association.

Results and Observations

Mean age observed in our study group was 23 yrs ranging between 18 yrs to 35 yrs. Placental volume ranged from 89.2 ml to 285.40 ml. Height of patients ranged from 140 cm to 165 cm, with a mean height of 151.30 cm. Weight of patients ranged from 34 kg to 70 kg with a mean weight of 50 kg. Hb in the study group ranged from 8 gm% to 12 gm% with a mean of 10.2 gm%. 73.3% of women had Hb levels less than 11 gm % representing anaemia in pregnancy (WHO, 1968). Out of these 16% had Hb levels < 9 gm %, 57.3% had 9-11 gm% and only 26.7% had Hb > 11 gm% i.e. nonanaemic group. Though the number of the sampled data was small this study shows the prevalence of anaemia in our country.

Serum ferritin ranged from 1 ng/ml to 110 ng/ml with mean of 26.5 ng/ml. 69.3% of patients had serum ferritin levels < 25 ng/ml reflecting poor iron stores in the sampled data, 12% had serum ferritin >50 ng/ml and 18.7% had serum ferritin between 25-50 ng/ml. As serum ferritin accurately reflects body iron under normal and pathological conditions (Puolakka et al, 1980), these observations suggest the prevalence of poor or absent iron stores in pregnant women in our country as more than two thirds of these women had serum ferritin levels less than 25 ng/ml.

Table I
Relation of maternal factors with mean placental volume in 16-20 weeks of gestation by univariate regression analysis.

Maternal factor	r	Regression Coefficient	(95% C.I.)	P
Age	0.0846	0.923	(-1.610 to 3.46)	0.4705
Height	0.1719	1.688	(-0.568 to 3.94)	0.1403
Weight	0.2897	2.170	(0.500 to 3.84)	0.0117
HB	-0.3669	-17.104	(-27.22 to —6.99)	0.0012
S. Ferritin	-0.5173	-11.968	(-16.59 to —7.35)	0.0000 (< 0.0001)

Table II
Relation of maternal variables with mean placental volume in 16-20 weeks of gestation by multiple regression analysis.

Maternal Factor	Regression coefficient	(95 % C.I.)	P
HB	-13.490	(-22.37 to —4.62)	0.0034
Serum Ferritin	-11.610	(-15.80 to —7.42)	0.0000(< 0.0001)
Age	-0.688	(-3.45 to 2.08)	0.6217
Weight	1.532	(0.09 to 2.97)	0.0375
Height	0.347	(-1.59 to 2.28)	0.7214

Placental volume was greater in heavier women and this relation was statistically significant (P=0.0117). Though the placental volume was observed to rise with rise in maternal age, and height this rise was not statistically significant (Table I, II).

Placental volume was found to be inversely related to maternal Hb and serum ferritin levels i.e. with increase in Hb and serum ferritin, placental volume fell and this fall was statistically significant (P=0.0012 for Hb, P<0.0001 for serum ferritin). (Table I).

Discussion

Mean placental volume was found to increase with

decrease in maternal hemoglobin and serum ferritin levels which was statistically significant (P=0.0034 for Hb, P=0.0000 i.e. < 0.0001 for serum ferritin)

Statistically significant increase in placental volume was observed with increase in maternal weight (P=0.0117) but the relation of other maternal variables like age, parity and height was not statistically significant.

These observations were supported by a study carried out by Howe (1995). He observed an inverse relationship between maternal Hb, serum ferritin and placental volume in a similar manner which was statistically significant. He further observed statistically significant rise in placental volume with increase in maternal height; this was not observed in present study. The possible reason could be large study group comprising of 530 women in his study and higher height of the women in western countries. His study group had maternal height ranging from <=159 cm to >= 167 cm grouped into approximate fours with more or less even distribution of patients in each group. Present study group comprised of only 75 women with height ranging from minimum of 140 cm to a maximum of 151.30 cm. Howe (1995) in his study found no statistically significant relation of maternal weight with placental volume. However the comparison with present study could not be made because Howe (1995) had not reported weight range of the sampled data in his article.

Low birth weight is linked with increase in blood pressure (Barker et al, 1990), increase in fibrinogen (Barker et al, 1992) and increase in total cholesterol & apolipoprotein B (Barker 1993).

Adult cardiovascular disease was also related to placental weight but in an opposing manner to birth weight. One factor shown to be associated with increased placental weight is the maternal hemoglobin level in pregnancy. Severe anaemia encountered in developing countries is associated with heavier placentae (Beischer et al, 1970).

Ferritin is principal storage form of iron and is the best indicator of iron stores in the body. Low ferritin levels indicative of low maternal iron stores were also associated with increased placental volume.

Instead of being directly linked to placental growth, low maternal iron and hemoglobin levels may be acting as markers of a more general nutritional deficiency in the mothers which in turn is associated with an increase in placental size and the initiation of metabolic programming in the fetus and so predisposing it to adult heart disease. However, prospective study is required to ascertain this in delivered population.

It is clear from present study that maternal hemoglobin and serum ferritin levels are inversely related to placental volume i.e. with increasing maternal hemoglobin and serum ferritin levels there was reduction in placental volume.

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