The significance of the relationship between serum levels of cobalamin and MCHC during pregnancy

N. G. CARRETTI (*) - A. G. EREMITA (*) - D. PATERNOSTER (**)
P. PELLIZZARI (**) - B. PORCELLI (***) - P. GRELLA (**)

Summary: Cobalamin concentration and mean corpuscolar haemoglobin concentration (MCHC) were found to have highly significant inverse correlation with the weeks of pregnancy (respectively -.278 $P<.0001$ and .342 $P<.00001$) in 205 pregnant women. Among all haematometric parameters cobalamin concentrations during pregnancy only correlates with MCHC ($P<.01$). This datum seems to indicate an influence of B_{12} on erythropoiesis which adequate the concentration of haemoglobin to circulatory modifications of pregnant women.

Key words: Cobalamin; Haematocrit; Pregnancy.

INTRODUCTION

Mean corpuscolar haemoglobin (MCH), one of the haematometric parameters, is the expression of the amount of haemoglobin, measured in pg/ml, which is contained in the average of red blood cells. The mean corpuscolar haemoglobin concentration (MCHC) represents the mean concentration of haemoglobin (in percentage) referred to a fixed volume (% ml) of pooled erythrocytes according to the following formula: MCHC = Hb (g/dl)/Htc × 100. In this report we wish to demonstrate the relationship between the serum levels of cobalamin (B_{12}) and MCH-MCHC during pregnancy.

(*) Clinica Ostetrica e Ginecologica dell'Università di Siena
(**) Clinica Ostetrica e Ginecologica dell'Università di Padova
(***) Istituto di Biochimica ed Enzimologia dell'Università di Siena

This study was supported by the Italian Ministery of the University and of Scientific Research (40% funds) for the project "Gestational capacity".

MATERIALS AND METHODS

224 women between the 6th and 42nd week of pregnancy were chosen without any particular criteria except the exclusion of preeclampsia and other severe pathological events. This sample of patients is representative of a normal population of pregnant women admitted to an Obstetrical Ward. At the time of admission to the hospital, a blood sample was taken from each woman to determine serum levels of B_{12} and haematometric parameters (red blood cells, haemoglobin (Hb), haematocrit (Htc), mean corpuscolar volume (MCV, MCH and MCHC). B_{12} was measured by the RIA "Dual Count No boil Kit-Medical System" method, in the Institute of Biochemistry and Enzymology from the University of Siena. The haematometric de-

Clin. Exp. Obst. Gyn. - ISSN: 0390-6663
XX, n. 1, 1993

Table 1. — *Descriptive statistic of variables: age, weeks, serum concentration of vitamin B_{12}, red blood cell count (RBC), haemoglobin (Hb), haematocrit (Htc), mean corpuscolar volume (MCV) mean corpuscolar haemoglobin (MCH) and mean corpuscolar haemoglobin concentration (MCHC).*

	No. cases	Minimum	Maximum	Mean	Standard dev.
Age (years)	221	17.59	44.98	29.62	± 5.24
Weeks of pregnancy	224	6.14	42.86	30.94	± 9.27
Vitamin B_{12} (pg/ml)	224	25.67	2400.00	360.37	±273.80
RBC (milions/mmc)	205	2.85	5.80	3.83	± 0.46
Hb (g/dl)	205	8.20	16.50	11.34	± 1.30
Htc (%)	205	24.80	47.80	34.36	± 3.72
MCV (fl)	205	60.10	112.90	90.18	± 7.82
MCH (pg)	205	17.70	36.10	29.72	± 2.77
MCHC (%)	205	27.30	36.00	32.96	± 1.30

termination was done in the Central Laboratories of the Hospitals of Siena (148 cases) and Padova (76 cases) with automatized techniques (respectively: System H2-Technicon and Counter Stakes-Coulter). Statistical analysis was performed using software for statistics and graphics mounted on a PC Macintosh SE/30 ([1]). Descriptive statistics of the variables examined are reported in Table 1 which shows the distribution of the studied values.

RESULTS

The relationship of the mean concentration of B_{12} and haematometric parameters with weeks of pregnancy demonstrate that both MCHC and B_{12} levels have a significant high correlation ($P<.001$) (Table 2).

In another study it was already shown that B_{12} concentration in pregnancy decreases mainly in the first 27 weeks ([2]).

The relationships between B_{12} and haematometric parameters is reported in Table 3.

B_{12} is correlated significantly to MCHC and it is not correlated to any other parameter including MCH, Htc and Hb.

DISCUSSION

The significance of this finding seems to refer to the haemodynamic modifications of pregnancy. The topics to be discussed are the following: 1) the parallel relationships of MCHC and B_{12} to weeks of pregnancy; 2) the relationship between B_{12} and MCHC.

The first topic is visually demonstrated by the LOWESS curves in figure 1.

Both the considered variables show a parallel decrease according to the weeks of pregnancy with the higher decrease in the first 27 weeks.

It is evident that the second phenomenon (the relationship between B_{12} and MCHC) is the consequence of the first.

Table 2. — *Relationship of haematometric parameters and cobalamin with weeks of pregnancy according to matrix of correlation of Pearson and matrix or probabilities.*

	Pearson Correlation matrix	Matrix of probabilities
	Weeks of pregnancy	Weeks of pregnancy
Weeks of pregnancy	1.000000	0.000000
Vitamina B_{12}	-0.278035	0.000054
RBC	-0.105262	0.133077
Hb	-0.134773	0.054023
Htc	0.007968	0.909724
MCV	0.129596	0.064026
MCH	-0.027284	0.697767
MCHC	-0.342175	0.000001

No. of observations: 205
Bartlett CHI-square statistic: 2710.268
DF = 28
Probability = 0.000

Table 3. — *Matrix of correlations and probabilities between haematometric parameters and the concentration of B_{12} during pregnancy.*

	Pearson Correlation matrix	Matrix of probabilities
	Vitamin B_{12}	Vitamin B_{12}
Vitamin B_{12}	1.000000	0.000000
RBC	0.109071	0.119529
Hb	0.103058	0.141436
Htc	0.052823	0.451927
MCV	-0.090236	0.198194
MCH	0.010997	0.875638
MCHC	0.219255	0.001585

No. of observations: 205
Bartlett CHI-square statistic: 2656.735
DF = 21
Probability = 0.000

A constant relationship between the concentration of Hb in 100 ml of pooled red blood cells and serum levels of cobalamin exists. This may not be demonstrated with the absolute value of Hb, with that of Htc nor with the number of red blood cells. This is probably because of the interference of haemodilution in pregnancy which does not allow a perfect adjustment between the circulation and blood volume; the haemoglobin concentration of a fixed quantity of red blood cells is perhaps, in this aspect, the most accurate point of reference. This correlation (B_{12} and MCHC) is lost under either of the two following circumstances; a) only considering the patients with Hb $\leq$ 11 g/dl (90 cases); b) only considering patients with a clearly pathological low level of B_{12} ($<$ 180 pg/ml, 39 cases). The fact that the relationship between B_{12} and MCHC can be demonstrated only considering pregnant women who are not anemic and who do not present low levels of Hb and B_{12} reinforces the concept that we face a physiological phenomenon.

Given that B_{12} acts on DNA in the process of erythroblast formation, a physiological concentration of cobalamin appears to be important in continuously confronting the formation of new cells which must synthesize a given concentration of Hb referred to a certain concentration of erythrocytes ([3]). In other words the relationships demonstrated seem to indicate a direct influence of B_{12} on erythropoiesis during pregnancy which adequate the mean corpuscolar haemoglobin concentration to the circulatory modification of the mother. There is no reason to exclude the offspring by the same influence, since cobalamin can cross placental wall.

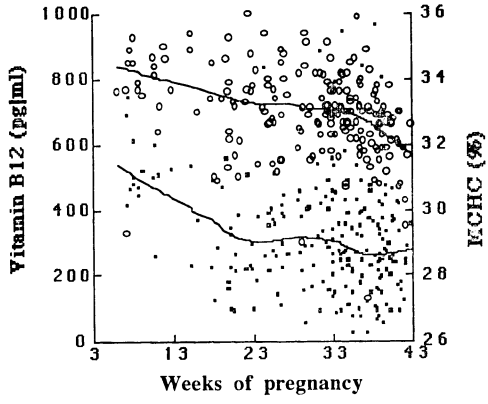

Fig. 1. — Relationships of B12 and MCHC levels to weeks of pregnancy according to LOWESS curves of regression.

REFERENCES

1) Wilkinson, Leland. Systat: "The system for statistics". Evanstone, Il Systat, Inc., 1989.
2) Carretti N., Eremita G. A., Porcelli B., Paternoster D., Grella P.: "Folate and vitamin B_{12} levels during pregnancy in normal and anemic patients". (Unpublished observation submitted to publication).
3) Chanarin I., Deacon R., Lumb M., Perry J.: "Cobalamin and folate: recent developments". *J. Clin. Pathol., 45,* 277, 1992.

Address reprint requests to:
N. CARRETTI
Clinica Ostetrica e Ginecologica dell'Università
Via P. Mascagni, 46 - 53100 Siena (Italy)