STUDY OF ERYTHROCYTE DEFORMABILITY IN PHYSIOLOGICAL PREGNANCY

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Summary: In the capillary areas erythrocyte deformability plays a significant part in determining perfusion and exchanges between blood and tissues. In fact, in the capillary areas, when the perfusion pressure diminishes, the erythrocytes no longer follow their linear trajectory movement but proceed randomly, thus favouring the phenomena of aggregation.

In pregnancy we find a physiological haemodilution consequent upon the proportionally greater increase in the plasmatic volume in respect to the cellular one. In physiological conditions such haemodilution reaches equilibrium between the plastic and cellular components which, according to data shown would favor erythrocytic distortion and consequently the perfusion of the peripheral areas. The deformability expressed by VRBC increases up to the 26th-28th week of pregnancy, then remains constant until full term.

The erythrocyte deformability may be defined as the result of the physico-chemical characteristics which allow erythrocytes, whose largest diameter normally exceeds 8 microns, to pass through the capillaries, whose diameter varies between 3 and 12 microns.

For the property to be activated, three conditions dependent on the erythrocytes are required: a) the integrity or the fluid structure of the cellular membrane ([9]); b) the fluidity of the cellular content, constituted by a concentrated solution or enzymes and haemoglobin ([5, 6]); c) the existing relationship between surface area and volume ([10, 22]), and a condition independent of the cellular structure: the pressure of perfusion ([7, 12]).

In the capillary area the pressure of perfusion and thus the speed of flow diminish, the erythrocytes in their movement therefore follow non-linear trajectories which favour the phenomena of aggregation ([19]).

Erythrocyte deformability thus takes on, just in the capillary areas, the significant role which determines the perfusion and the gas-exchanges between blood and tissue ([2, 7, 11, 21]).

Our interest in the study of erythrocyte deformability in pregnancy derives from the observations of Chien (1970) ([4]) and of other Authors ([1, 3, 24, 25]) according to whom the effect of the haematocrite on the speed of flow is greater at the low strength of distortion which is found in fact in the capillary circles.

As we know, during pregnancy the haematic volume increases by 30-35% ([17, 18]). This increase begins around the 7th-8th week of pregnancy and continues until the 24th week, after which it is placed on constant values for a brief period before declining at the end of pregnancy, and returns to the non-pregnant condition after delivery ([14]).

The increase in the volume of the plasma is proportionally greater in respect to the volume of the red cells, which is followed by a haemodilution with iron and pholate values within the limtis of the norm ([23]).

Gravidic haemodilution is accompanied by modifications of different haematochemical parameters, among which fibrinogen, which according to Chien (1970) has the greatest responsability for the aggregation and therefore for the erythrocyte deformability at low speeds of flow.

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Table 1. — *Average and standard deviations of VRBC, Hmt and Fibrinogen values calculated by group per week.*

Weeks	12-15	16-19	20-23	24-27	28-31	32-35	36-39	40
VRBC ml/min	0.66± 0.07	0.80± 0.06	0.89± 0.07	0.97± 0.04	0.92± 0.04	0.92± 0.05	0.97± 0.05	0.96± 0.03
Hmt %	34.3± 2.9	33.0± 2.3	32.7± 2.5	31.7± 1.8	31.7± 2.4	31.2± 1.9	32.0± 2.0	30.9± 2.3
Fibrin. g/ml	360± 42	425± 60	380± 30	360± 25	362± 32	390± 40	410± 46	420± 35

METHODS AND CRITERIA IN THE SELECTION OF PATIENTS

We studied erythrocyte deformability using the method of filtration on polycarbonate membrane (Nucleopore) with pores of an average diameter of 5 microns. The passage of blood samples through the membrane was obtained by constant negative pressure of 20 cms of water with the apparatus suggested by Reid and Dormandy (1976) ([20]).

The blood samples were collected by antecubital venopuncture of the forearm, without determining stages with haemostatic strap, and then placed in a plastic test-tube EDTA potassium 2%, buffered by pH 7.4 in the ratio of 0.5 per 10 ml of blood. The samples were thermostated at 37 °C for at least ten minutes before assay.

Each sample was checked three times for the determination of the filtration time, each time using new filtering membranes, and calculating the average of three measures.

Each extraction was seconded by the determination of the Hmt and the fibrinogen.

The filtration time indicates the time taken to filter a known volume of whole blood (1 ml). Such measure was corrected with the haemocratic value to indicate the speed of erytrocytary filtration (ml/min) ($VRBC = \frac{Hmt}{t} \times 60$).

We examined 40 women in their first pregnancies, with ages ranging between 20 and 32 years. Before being included in the study they were investigated anamnestically and through routine haemotochemical tests. They underwent an ECG and an objective general examination in order to exclude organo-pathologies, infectious or dismetabolic, and we checked their dietetic health habits (smoking and alcohol).

During the course of the study patients were eliminated who, for obstetric reasons, required specific treatments (threatened miscarriage, threatened premature delivery, precocious rupture of the ovulary membrane, preclampsia, hypertension, orthostatic edema, diabetes and infections ilnesses).

"Extractions of blood samples were planned at intervals of 4 weeks until the end. The data collected were grouped according to the week of pregnancy.

RESULTS

Not all the women entered the program in the same week of pregnancy (anamnestically and echographically calculated): eignt in the 12th week, seven in the 13th, ten in the 14th and fifteen in the 15th. Since the same women were reevaluated every four weeks, we calculated the average ± DS of the parameters examined in the four-week intervals as reported in the following table (tab. 1).

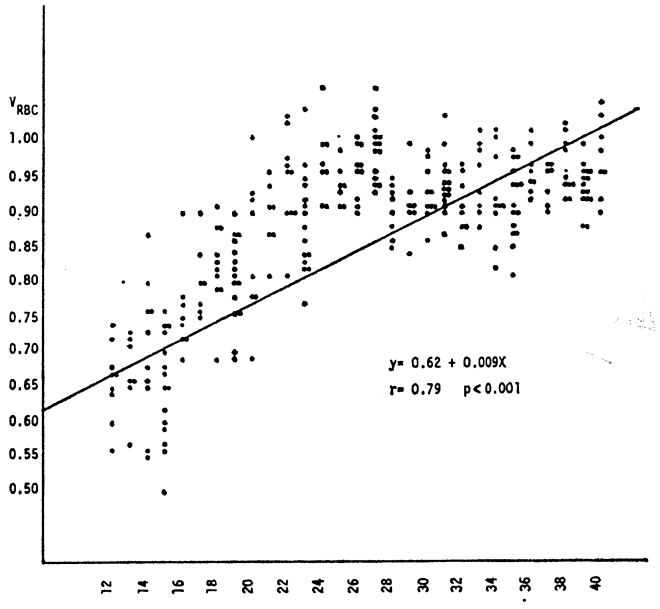

Fig. 1. — Distribution of VRBC values in relation to gestational weeks.

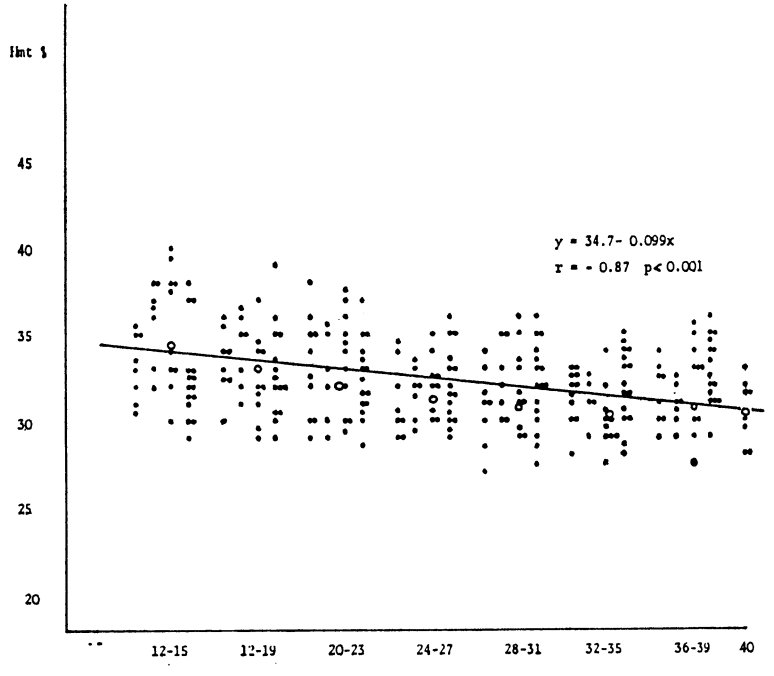

Fig. 2. — Distribution of Hmt values in relation to gestational weeks.

The filterability expressed by VRBC increased gradually up to the 26th-28th week, then remained fairly constant until the end, when it seemed to increase again.

The Hmt diminished progressively by values from 34.3 ± 2.9 at the beginning of pregnancy to 30.9 ± 2.3 towards the end. The fibrinogen rose from 360 ± 42 g/100 ml to 420 ± 54 g/100 ml.

The statistical analyses of the data collected showed significant correlation between VRBC and week of pregnancy by $r = 0.79$ with $p < 0.001$, allowing us to draw the line of relation $y = 0.62 + 0.009\ X$ (graph 1).

A correlation also exists between VRBC and the Hmt values by $r = -0.90$ with $p < 0.001$ ($y = 40.4 - 9.29\ X$). No significant correlation was revealed in the fibrinogen value.

CONCLUIONS

The data obtained confirm the experiments of different Authors ([8, 15, 16, 26]) on the therapeutic use of normovolemic haemodilution.

The physiological haemodilution of pregnancy, through a reduction of haemotocritic value causes the destabilisation of the rouleaux, hindering the formation of erytrocytary aggregates and reducing the relative viscosity of the plasma, a similar effect to that which is obtained through the use of diluent infusions.

The trend of the VRBC values which, as can be seen from the graph, increases considerably up to the 26th-28th week, thereafter tending to stabilise until the end. This might be explained by the hypothesis of an adaptation of the maternal organism to the growing metabolic and functional exigencies which would be complete by about the 26th-28th week of pregnancy. The maternal haematic ambient, thanks to the changes the gravid condition brings, shows an equilibrium between the plasmatic and cellular components such as to favor the perfusion of all the microcirculatory areas ([13]).

Although we were conscious of the objective limitations inherent in the method of the tests we used in this study of erythrocyte deformability in pregnancy, we thought it might give some support to the traditional deliberations addressed to the study of maternal-fetal wellbeing. The data collected through its application to the study of a group of normal cases may constitute a point of reference for future applications.

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THE DIAGNOSIS OF ECTOPIC PREGNANCIES IN CASES OF LOWER ABDOMINAL PAIN USING BETA SUBUNIT ASSAY OF HUMAN CHORIONIC GONADOTROPIN

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Summary: The role of beta-subunit assay of human chorionic gonadotropin (hCG) in the early and accurate diagnosis and treatment of ectopic pregnancy was evaluated prospectively in a group of 57 women who presented with lower abdominal pains. A flow scheme for diagnosis work-up based primarily on hCG beta-subunit assay resulted in no false negative result. This enabled early and conservative treatment of the condition. Ectopic pregnancy was diagnosed early in more than one third of the patients. As a result conservative treatment was performed in cases were it was required and medically possible (33% of the cases).

INTRODUCTION

Ectopic pregnancy constitutes one of the few surgical emergencies in gynecology. The condition is relatively common, and the frequency is increasing ([1, 2]). The major risks are directly related to the delay in establishing diagnosis and initiating treatment, mainly due to the inconsistency of signs and symptoms. Abdominal pain and irregular bleeding are the most frequent symptoms of ectopic pregnancy, but they are also the most common complaints encountered in all gynecologic fields.

The immunologic test based on the inhibition of agglutination (HIT) by urinary human chorionic gonadotropin (hCG) has a sensitivity of approximately 1000 IU/l and has been reported to give positive results in only 50-80% of patients with ectopic pregnancy ([3, 4]). Earlier and

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