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MODIFICATIONS OF ERYTHROCYTE AGGREGATION DURING LABOR AND DELIVERY

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ABSTRACT

Pregnancy is associated with erythrocyte hyperaggregation which acutely returns to baseline during delivery, while a transient hyperviscosity syndrome induced by uterine contractions can be observed. We aimed at analyzing more precisely the modifications of erythrocyte aggregation during labor. 71 uterine contractions in 30 pregnant women (19-45 yr, mean 27.2 ± 9) were studied, with RBC aggregation (SEFAM erythroaggregometer) measured before, during and after the contraction. Aggregation indices at 10 and 60 sec progressively increased throghout labor ($p<0.01$). Partial and total dissociation thresholds progressively decrease during labor with a nadir (-10%) at delivery ($p<0.01$). The aggregation time is transiently shortened ($p<0.01$) during labor. Although previous measurements with the Myrenne aggregometer showed only during labor a return to nonpregnant values, this analysis by laser backscattering indicates that the stressful events which occur during uterine contractions increase the tendency of RBCs to form aggregates, although they disaggregate more easily.

Key words: labor, erythrocyte aggregation, hemorheology

INTRODUCTION

During pregnancy, blood rheology is markedly modified (1-5). One of the most important hemorheologic changes during this period is an increase in erythrocyte aggregation (6-7). This parameter acutely returns to baseline during delivery (2). However, delivery is not only marked by the return of blood rheology to non-pregnant values. There is also a transient hyperviscosity syndrome which seems to result mostly from uterine contractions (8). Therefore, the modifications of a complex biological phenomenon such as RBC aggregation might be less simple than a return to baseline values. It could be hypothesized that some parameters of RBC interactions are also influenced by the stressful events which occur during delivery. Since laser backscattering offers a more precise analysis of RBC aggregation than the light transmission method (9-10) we investigated the modifications of erythrocyte aggregation at the end of pregnancy with this technique.

MATERIAL AND METHODS

patients.

30 pregnant women (19-45 yr, mean 27.2 $\pm$ 9) were studied. Labor occurred spontaneously at 37-42 wk gestation. RBC aggregation was measured before, during and after each contraction. A total number of 71 uterine contractions was studied: 24 before 4 cm dilatation, 26 after 4 cm dilatation, 21 during delivery. No medication (e.g. analgesia) was given.

instrumentation

Blood was drawn on vacutainer tubes, from a catheter set in the antecubital vein. The anticoagulant was EDTA (0.18% EDTA K_3). Hematocrit was adjusted to 40% $\pm$ 0.5 % by removal or adjustment of plasma. RBC aggregation was measured with the SEFAM aggregometer which is based upon the experiments of Mills (13-14) on cell disaggregation behavior in shear flow. This device measures the changes in backscattered light which are observed when sheared RBC suspensions are abruptly brought to a full stop. The decrease in the optical signal reflects the formation of RBC aggregates (11). Some parameters are derived from the curve of light intensity as a function of time. The aggregation time is the reciprocal of the initial slope (calculated between 0.5 and 2 sec after the shear has stopped). The aggregation index at 10 sec is a measurement of the extent of erythrocyte aggregation and is the relative surface area above the curve calculated over the first 10 seconds. This device measures also disaggregation thresholds, by submitting blood to a succession of shear rates from 600 s^{-1} to 7 s^{-1}. The total disaggregation threshold is the shear rate below which the backscattered light intensity starts to decrease, indicating that the shear stress applied to aggregates is no longer sufficient for allowing complete dispersion of RBC aggregates. The partial disaggregation shear rate is defined as the shear rate corresponding to the

intersection point of the two asymptotes drawn from the extremes (maximum and minimum shear rate). Statistical analysis was performed by one way analysis of variance (ANOVA).

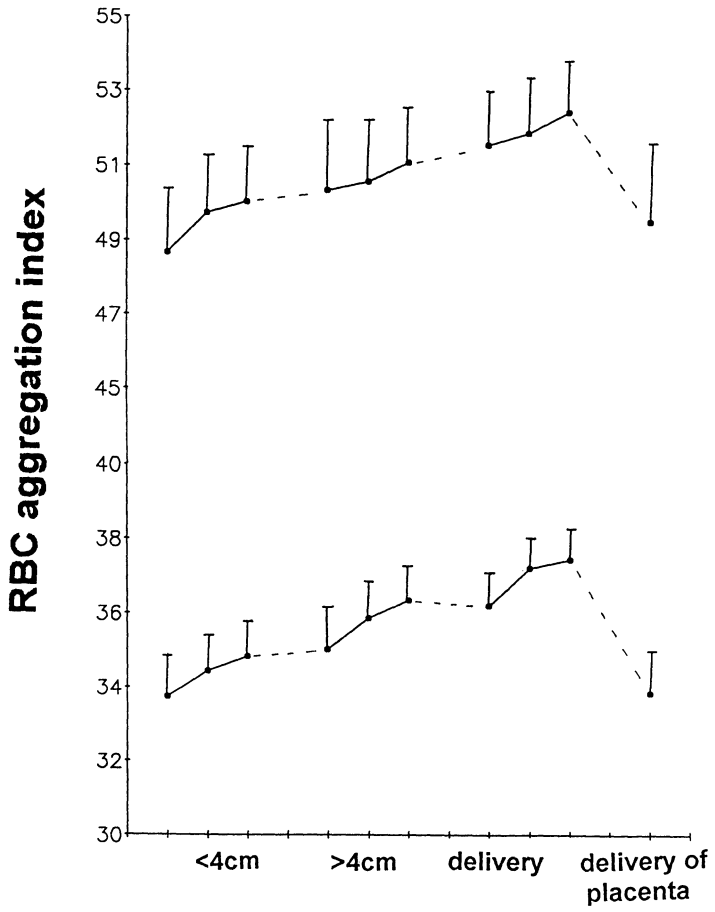

FIG.1
Evolution of RBC aggregation indices (see text) during uterine contractions at different moments of labor and delivery. Upper line: index at 60 s; lower line: index at 10 s. The increase is significant during each uterine contraction (ANOVA $p<0.01$) as well as during the whole process of labor (ANOVA $p<0.01$).

RESULTS

Fig. 1 shows that aggregation indices at 10 and 60 sec progressively increased throghout labor ($p<0.01$) and return after delivery to the value observed at the beginning of labor. Fig. 2 shows that the aggregation time is transiently shortened ($p<0.01$) during labor. Fig 3 shows that the partial dissociation

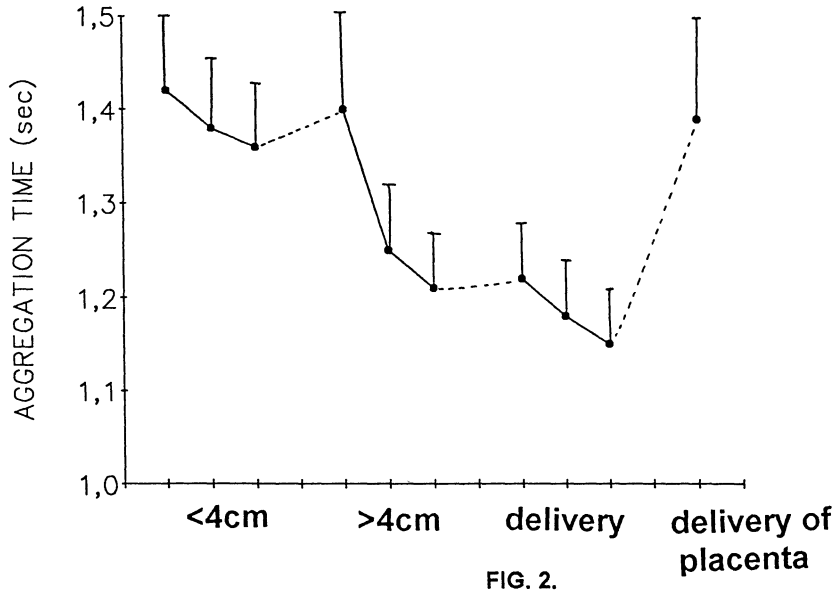

FIG. 2.

Changes in RBC aggregation time during labor. This parameter decreases during uterine contractions (ANOVA $p<0.01$) and exhibits a general decrease throghout labor (ANOVA $p<0.01$).

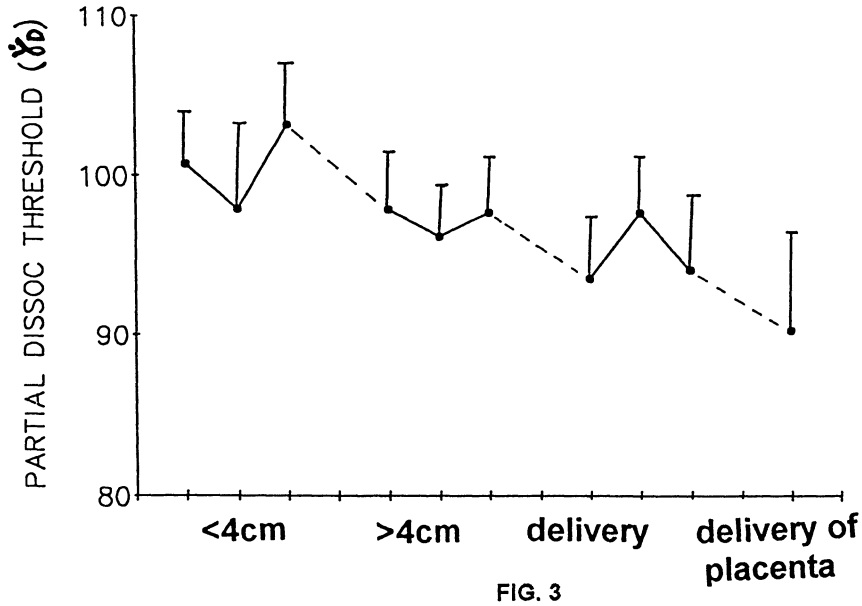

FIG. 3

Changes in RBC partial disaggregation threshold during labor. This parameter decreases during uterine contractions (ANOVA $p<0.01$) and exhibits a general decrease throghout labor (ANOVA $p<0.01$).

thresholds progressively decrease during labor with a nadir (-10%) at delivery ($p<0.01$).

DISCUSSION

Our preceding studies on blood rheology during labor used another technique for measuring RBC aggregation: the light transmission method, derived from the works of H. Schmid-Schönbein (15) and widely used among hemorheologists (Myrenne aggregometer). We observed two points: RBC aggregation, which is high during pregnancy, decreases during delivery and returns to non-pregnant values; this decrease occurs gradually , during each uterine contraction. (8-9). We postulated that this decrease was due to the physiological decrease in fibrinogenemia during labor (16).

The picture when RBC aggregation is measured by laser backscattering is quite different. The decrease in RBC aggregation threshold indicates that RBCs become more easily dissociable, consistent with our previous observations. However, we find also some modifications reflecting increased aggregation: shorter aggregation time, higher aggregation index at 10 and 60 sec.

Thus, beside the return to the flow condition of a non-pregnant organism, some aspects of RBC aggregation reflect the transient hyperviscosity syndrome we previously described during labor (8-9).

The physiological relevance of these complex hemorheologic modifications during labor and delivery remains unclear. Some of the rheologic changes, resulting in transient hyperviscosity, may decrease blood flow in order to reduce blood loss during this highly hemorragic period. However, our understanding of the influence of RBC aggregation on blood flow at the different levels of circulation remains uncomplete and no clear interpretation can be given. By contrast, a reduction of the disaggregation threshold is probably beneficial for O_2 delivery, since studies in peripheral obliterative arterial diseases (in diabetic subjects) showed a negative correlation between this threshold and transcutaneous O_2 pressure (17). The causal mechanism of these rheologic modifications, which are probably due to metabolic and hormonal changes during labor, remain also to be studied.

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