Maternal serum cortisol and prolactin variations during labor

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Summary: Maternal serum cortisol (F) and prolactin (PRL) levels were measured during labor in 20 uncomplicated pregnancies. Four pregnant women were admitted with ruptured membranes (RM group) and 16 were admitted with intact membranes (IM group), ten with spontaneous onset of labor (SL group) and 10 with induced labor (IL group), five with a prolonged for duration labor (PL group) and 15 with a normal for duration labor (NL group). Before the inset of labor F levels were statistically higher ($p<0.05$) in the RM group ($x=975$ ng/ml), than in the IM group ($x=664$ ng/ml), and also in the SL group ($x=783$ ng/ml), than in the IL group ($x=679$ ng/ml). During labor, in all twenty pregnant women a marked rise of F (from $x=726$ ng/ml before the onset of labor, to $x=911$ ng/ml) and a marked fall of PRL (from $x=161$ ng/ml to $x=122$ ng/ml) were observed ($p<0.05$). In the PL group the F elevation and the PRL drop were more pronounced ($p<0.001$). After placental separation, PRL levels increased slightly while F values remained unchanged. These changes in hormone levels before and during labor could be attributed to the emotional and physical stress of labor.

Key words: Maternal serum; Prolactin; Cortisol; Labor.

INTRODUCTION

It is well known that in pregnancy, serum prolactin values rise progressively, reaching peak values of about 10-fold compared to the nonpregnant values, between 38 and 40 weeks gestation ([1]) and that cortisol level is also higher during late pregnancy ([2]). Besides, the secretion of both hormones in correlated with various types of stress in non pregnant states ([3]). Labor, with its accompanying pain, can be regarded as a stress, in which the body's capacity for emergency adaptation is called upon. The result is an increased output of adrenaline and noradrenaline ([4]) and of maternal blood ACTH and cortisol level ([5]). A direct correlation between cortisol and prolactin secretion is reported by some investigators ([6]) while a decrease in prolactin level during labor has been shown by others ([7]). The purpose of this study is to investigate maternal blood cortisol and prolactin levels during labor and the possible correlation between them, as well as the influence of the way of the onset of labor, and of its progress and duration, on the levels of these two hormones.

MATERIALS AND METHODS

The series comprised 20 healthy mothers whose pregnancies had been uncomplicated and had lasted for 38-41 weeks. These women gave birth to 9 female and 11 male healthy infants by vaginal delivery. Eleven women were primiparas and 9 multiparas. The women were divided into 3 pairs of groups: The first pair included 4 women with ruptured membranes (RM group) and 16 with intact membranes (IM group) at the time of admission. The second pair was

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composed of 10 women with spontaneous onset of labor (SL group) and 10 with induced labor, by oxytocin infusion (IL group). The third pair included 5 cases with prolonged labor (PL group) and 15 cases with normal for duration labor (NL). All the parturients received oxytocin and they were under cardiotocography during labor. Sixty maternal blood samples were collected, three from each patient. The first sample (sample A before the onset of labor, the second (sample B) at 5 cm cervical dilatation and the third (sample B) at 5 cm cervical dilatation and the third (sample C) 10 minutes after placental separation. The blood samples were allowed to clot and then they were centrifuged. The serum was separated in small aliquots and was refrigerated until assayed. The hormone measurements were determined by enzyme immunoassays (EIA). The results were analysed statistically by the student-test.

RESULTS

As is shown in Table 1, cortisol levels in sample A were statistically higher ($p < 0.05$) in the RM group ($x = 975$ ng/ml) than in the IM group ($x = 664$ ng/ml), and they were also higher ($p < 0.05$) in the SL group ($x = 783$ ng/ml) than in the IL group ($x = 679$ ng/ml). On the contrary, no statistical difference was observed in prolactin levels between the groups of the two pairs.

As is shown in Table 2, all 20 parturients had a marked rise in cortisol levels, from $x = 726$ ng/ml in sample A to $x = 911$ ng/ml in sample B and a marked drop in prolactin levels was more pronounced in the group of PL ($p < 0.001$).

In sample C, cortisol levels remained stable, as well as in sample B, while prolactin levels had a rise from $x = 122$ ng/ml (in sample B) to $x = 143$ ng/ml (Table 3).

Table 1. – *Mean values (x) of cortisol and prolactin levels in sample A.*

	Group of parturients			
	IM	RM	SL	IL
Cortisol (ng/ml)	664*	975	783*	679
Prolactin (ng/ml)	165	144	159	159

(*) $p < 0.05$

Table 2. – *Alteration in cortisol and prolactin levels (mean values, x) from sample A to sample B.*

		Group of parturients		
		PL	NL	All 20 parturients
Cortisol (ng/ml)	A sample	760**	643	726*
	B sample	962	791	911
Prolactin (ng/ml)	A sample	174**	160	161*
	B sample	119	135	122

(*) $p < 0.05$
(**) $p < 0.001$

Table 3. – *Cortisol and prolactin levels (mean values, x) in A, B, C samples.*

	Samples	All 20 parturients
Cortisol (ng/ml)	A	726
	B	911
	C	926
Prolactin (ng/ml)	A	161
	B	122
	C	143

In Figure 1, cortisol values of all 20 women, measured by samples A, B, C are shown. Black circles are for the IM group's values and clear circles for RM the group's values. The black line is for the mean value and the dotted lines for standard deviations.

In Figure 2, prolactin values are shown in the same way.

DISCUSSION

The observation that the RM group of patients had statistically higher cortisol levels than the IM group in the sample A, might imply a well-debated and controversial subject: either that membrane rupture is followed by a sharp rise of maternal blood cortisol or it is induced by this rise. The role of cortisol in the initiation of the biochemical events of parturition

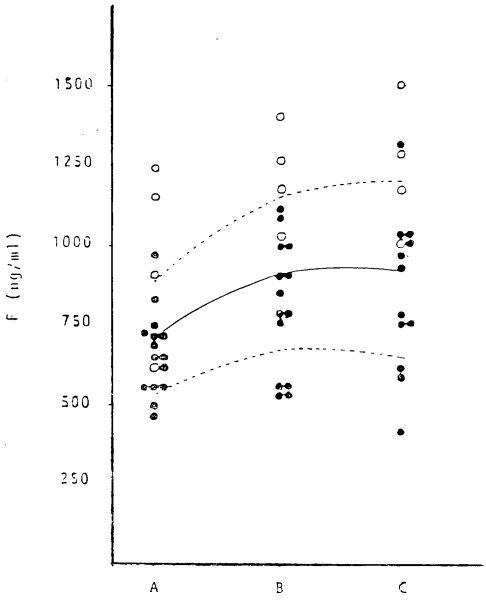

Fig. 1. — Maternal serum levels of cortisol (F) during labor. O, values in the RM group; ●, values in the IM group ——, mean value; – – –, standard deviation.

had been discussed as early as 1933 and that theory was supported 40 years later by the results of the elegant studies of Liggins [8]. Later on, however, the "cortisol theory" was not confirmed, mainly because of the failure of the onset of labor by the administration of either cortisol or ACTH [9]. Besides, it is possible, that both cortisol elevation and rupture of the membranes are due to accessory phenomena before the onset of labor, such as the physical or phychological stress of muscular effects (false labor) [2].

The role of prolactin in the initiation of labor is still obscure. Our findings on the lack of statistical difference in PRL values between the RM and the IM group and between the SL and the IL group, might suggest that maternal PRL is not important in the onset of labor. Tyson *et al.* [10] found that, ovine PRL modified the production of prostablandin by fetal membranes in vitro and presumed that, by analogy, endogenous PRL by human decidual tissue (=amniotic fluid PRL) might also inhibit the elaboration of prostaglandin E_2 from its precursors until membranes disruption occurs, when its inhibition is lifted. On the other hand, according to Riddick *et al.* [11], there is a lack of correlation between maternal, fetal and amniotic fluid levels of PRL.

The hormone levels in sample B showed remarkable alterations from those in sample A. The statistically significant increase of cortisol was due to the stress of labor [12, 13], especially in the PRL group (where all 5 women were primiparas) because of the prolongation of the first stage of labor. Higher cortisol levels have been found by some investigators in nulliparas compared to multiparas. We did not find such a difference in our material.

The prolactin decline during labor is not in agreement with the known prolactin elevation after various types of stress such as surgery, anaesthesia and physical exercise. The rise of circulating pro-

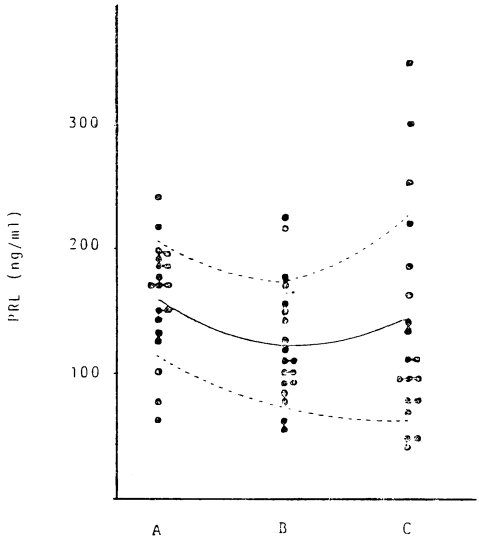

Fig. 2. — Maternal serum levels of prolactin (PRL) during labor. ——, mean value; – – –, standard deviation.

lactin at the end of pregnancy, by 10-fold compared to nonpregnant values, may be attributed to the blunting of the responsiveness of the hypothalamic prolactin mechanism. Another hypothesis implicates a transient increase in dopaminergic activity during labor, especially in a painful one, due to adrenalin secretion, leading to a PIF (prolactin inhibiting factor) increase and, thus, a prolactin drop ([14]). Alternatively, the rapid decline of PRL levels during active labor may be causally related to an increase in oxytocin levels, which has been shown to inhibit PRL secretion, according to Lympsin *et al.* ([15]), who made this observation during experimental work in rats. Hormone levels in sample C, ten minutes after placental separation, remained stable in the case of cortisol because this time lapse is too small, compared with cortisol half life, and showed a slight increase, in the case of prolactin. This slight increase of PRL, ten minutes after delivery, is in accordance with the findings of Rigg and Yen ([7]), who observed that after PRL levels reaching a nadir, about two hours prior to delivery, there is some recovery short by before delivery, leading to a dramatic upward surge of PRL levels during the first two hours after delivery.

In conclusion, we can say that:

a) Both cortisol and prolactin reach high values at the beginning of labor;

b)the type of onset of labor seems to influence cortisol levels but not those of prolactin;

c) in the middle of labor cortisol and prolactin show a negative correlation.

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