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hCS, estriol and oxytocinase in maternal serum and neonatal condition in high risk pregnancies

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1 Introduction

Medical interest at present is not limited to the knowledge of fetal growth but has been extended to learn about fetal health. In order to find a reliable index of fetal wellbeing, maternal hormone levels were related with condition of the neonate as reflected by the APGAR score.

2 Material and methods

The same population of high risk pregnancies and the same hormone and enzyme determinations of the preceding paper were used for this study. The condition of the newborn was evaluated by the APGAR score at the first and fifth minutes of life.

The neonates were divided into two groups according to their vitality: depressed (APGAR score 0–6) and vigorous (APGAR score 7–10).

When the mean birthweights of both groups were statistically different, maternal estriol levels were corrected so as to avoid the influencing factor of newborn weight, as was shown in our previous paper.

Maternal estriol values were adjusted to the theoretical value corresponding to the mean birthweight of the study population. The lineal regression analysis data between maternal estriol and the birthweight of each of the two groups was used.

The correction was made according to the following mathematical calculation:

$$\left[\begin{array}{c} \text{Corrected} \\ \text{hormone} \\ \text{value} \end{array} \right] = \left[\begin{array}{c} \text{Actual} \\ \text{hormone} \\ \text{value} \end{array} \right] - (\text{Actual weight} - \text{Mean weight}) \times b$$

where b is the slope of the lineal regression analysis.

3 Results

No differences were found in the incidence of elective cesarean section, intrapartum cesarean section or vaginal delivery (FISHER test) between depressed and vigorous neonates.

When the levels of estriol in all high risk pregnancies were compared according to neonatal vitality, it was found that depressed newborns were associated with lower maternal serum estriol levels than vigorous neonates.

The mean value in those pregnancies whose neonates were depressed ($n = 18$) was $26.25 \text{ ng/ml} \pm 15.32 \text{ SD}$. That of the mothers whose neonates were vigorous ($n = 37$) was $46.73 \text{ ng/ml} \pm 17.69 \text{ SD}$. The difference between both values was significant ($p < 0.001$) (Fig. 1).

The same difference was observed at the fifth minute of life. The mean value of serum estriol in pregnancies with depressed newborns at the fifth

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Fig. 1. Mean maternal estriol values obtained the week before delivery in both groups, depressed and vigorous neonates at the 1st. and 5th minutes of life, in 55 high risk pregnancies.

minute ($n = 8$) was $30.89 \text{ ng/ml} \pm 14.17 \text{ SD}$ while that of those with vigorous newborns ($n = 47$) was $41.48 \text{ ng/ml} \pm 19.95 \text{ SD}$. This difference was not statistically significant ($p > 0.05$). The comparisons are shown in Fig. 1.

The mean birthweight of depressed infants ($2,382.75 \text{ g}$) was statistically lower than that of the vigorous group ($3,044.75 \text{ g}$).

In the attempt to avoid birthweight as an influencing factor in hormonal level, this was adjusted according to the corresponding value of the mean birthweight of all the neonates, using the lineal regression analysis data between maternal estriol and birthweight of each group.

The corrected mean maternal serum estriol values of vigorous neonates was 45.44 ng/ml and that of depressed ones, 25.14 ng/ml . The difference was statistically significant ($p < 0.001$) (Fig. 2).

Mothers whose newborns were depressed at the first minute of life showed lower levels of serum hCS than those with vigorous infants. The mean value in the former group ($n = 18$) was $6.34 \text{ ug/ml} \pm 3.08 \text{ SD}$ while in the other group ($n = 37$) it was $7.44 \text{ ug/ml} \pm 3.77 \text{ SD}$. The student test did not show a significant difference between both groups.

Furthermore, those newborns who were still depressed at the fifth minute of life, were associated

Fig. 2. Mean maternal estriol levels, corrected for birthweight, during the week before delivery, in depressed and vigorous neonates at the first minute of life. Same group of high risk pregnancies as in Fig. 1.

with higher maternal hCS levels than the vigorous neonates. Mean value of hCS of the mothers with depressed newborns ($n = 8$) at the fifth minute was $7.89 \text{ ug/ml} \pm 3.23 \text{ SD}$, while in the mothers with

vigorous newborns ($n = 47$) it was $6.94 \text{ ug/ml} \pm 3.63 \text{ SD}$. The difference was not statistically significant.

There was no significant difference between serum oxytocinase levels of mothers with depressed or vigorous newborns either at the 1st or 5th minute of life.

Those mothers with depressed infants at the first and fifth minutes had $5.51 \text{ mg} \pm 2.83 \text{ SD}$ and $5.93 \pm 2.54 \text{ SD}$ β naftilamide/100 ml/hour, respectively, and those whose newborns were vigorous at the first and fifth minutes had $6.6 \text{ mg} \pm 2.76 \text{ SD}$ and $6.36 \text{ mg} \pm 2.88 \text{ SD}$ respectively.

When a mathematical treatment similar to that used for estriol was applied to hCS and oxytocinase levels, no statistical difference was found. When patients were divided according to maternal diseases, serum estriol levels of the mother were statistically different according to the Apgar score of the newborns.

The mean estriol value in serum of diabetic mothers whose newborns were depressed at the first minute ($n = 6$) was $30.82 \text{ ng/ml} \pm 15.11 \text{ SD}$ and in those with vigorous infants ($n = 10$), $53.89 \text{ ng/ml} \pm 17.33 \text{ SD}$ ($p < 0.02$). When we compare estriol levels according to Apgar score at the 5th minute there was no statistically significant difference (Fig. 3).

In this group the mean birthweight of vigorous neonates was 2,936 g and that of depressed ones was 3,029 g. There was no statistically significant difference between them.

When the mean values of estriol levels of mothers with vascular pathology were compared, those whose newborns were depressed at the first minute ($n = 9$) had a mean value of serum estriol of $25.07 \text{ ng/ml} \pm 16.05 \text{ SD}$ and that of those with vigorous neonates ($n = 8$) was $44.84 \text{ ng/ml} \pm 22.65 \text{ SD}$. This difference was not statistically significant. The comparison according to the APGAR score at the 5th minute was not significant either ($22.12 \text{ ng/ml} \pm 15.94 \text{ SD}$ and $36.01 \text{ ng/ml} \pm 21.89 \text{ SD}$, respectively).

Again in this group the mean birthweights of vigorous and depressed newborns were different, 2,973 g for the first group and 2,377 g for the latter.

The same correction of maternal hormonal levels according to the mean birthweight of the group was done. The corrected level of maternal estriol corresponding to vigorous neonates was 49.08 ng/ml and for depressed newborns, 27.00 ng/ml . The difference between both values was now statistically significant ($p < 0.05$) (Fig. 4).

In Rh sensitized patients, the mean serum estriol level corresponding to vigorous newborns at the

Fig. 3. Mean estriol value in serum of 16 diabetic mothers when their newborns were depressed or vigorous at the 1st. and 5th minutes of life.

Fig. 4. Corrected level of maternal estriol in 17 mothers with vascular pathology when their newborns were depressed or vigorous at the first minute of life.

first minute ($n = 9$) was $47.91 \text{ ng/ml} \pm 12.59 \text{ SD}$, higher than that for depressed newborns ($n = 3$), $34.17 \text{ ng/ml} \pm 8.28 \text{ SD}$. The difference was not statistically significant. The same occurs when we compared estriol values according to the APGAR score at the 5th minute ($38.10 \text{ ng/ml} \pm 6.65 \text{ SD}$ and $45.75 \pm 13.70 \text{ SD}$, respectively).

When hCS and oxytocinase levels were compared, there was no statistically significant difference between mothers with vigorous infants and those with depressed neonates, either at the first or fifth minutes of life (Tab. I).

The same results were found when the different groups of patients were studied (Tabs. II and III).

Furthermore, mothers with vascular pathology had higher hCS levels when their newborns were depressed at the fifth minute of life ($n = 3$), $11.0 \text{ ug/ml} \pm 3.17 \text{ SD}$ than when newborns were vigorous ($n = 13$), $6.05 \pm 3.68 \text{ SD}$ ($p < 0.05$).

When maternal hCS and oxytocinase levels were studied in the different groups of patients according to the Apgar score at the fifth minute of life, no statistically significant differences were found.

The same results were obtained for maternal serum levels of the three substances studied when only those mothers with low birthweight infants were considered.

4 Discussion

By studying placental endocrine functions through hCS, estriol and oxytocinase determinations, it was attempted to evaluate indirectly placental transfer functions. To achieve this, maternal serum

Tab. I. Comparison of hCS and oxytocinase levels in mothers with vigorous and depressed newborns.

	APGAR score at the first minute		“t” value
	0-6 $\bar{x} \pm \text{SD}$	7-10 $\bar{x} \pm \text{SD}$	
hCS	$6.34 \text{ ug/ml} \pm 3.05$ $n = 18$	$7.44 \text{ ug/ml} \pm 3.71$ $n = 37$	1.075 NS
Oxytocinase	$5.51 \text{ mg } \beta\text{Naft} \pm 3.00$ $n = 16$	$6.6 \text{ mg } \beta\text{Naft} \pm 2.75$ $n = 29$	1.260 NS
	APGAR score at the fifth minute		“t” value
	0-6 $\bar{x} \pm \text{SD}$	7-10 $\bar{x} \pm \text{SD}$	
hCS	$7.89 \text{ ug/ml} \pm 3.22$ $n = 8$	$6.94 \text{ ug/ml} \pm 3.63$ $n = 47$	0.689 NS
Oxytocinase	$5.93 \text{ mg } \beta\text{Naft} \pm 2.54$ $n = 7$	$6.36 \text{ mg } \beta\text{Naft} \pm 2.88$ $n = 36$	0.398 NS

NS = not significant

Tab. II. hCS levels in pregnancies according to maternal disease

Maternal Diseases	APGAR score at the first minute		
	0 - 6 $\bar{x} \pm SD$	7 - 10 $\bar{x} \pm SD$	"t" value
Diabetes	6.38 ug/ml $\pm$ 3.44 n = 7	7.80 ug/ml $\pm$ 4.32 n = 9	0.708 NS
Vascular Diseases	6.94 ug/ml $\pm$ 3.98 n = 10	7.05 ug/ml $\pm$ 4.43 n = 6	0.051 NS
Rh Isoimmunization	7.23 ug/ml $\pm$ 4.71 n = 10	7.96 ug/ml $\pm$ 3.19 n = 10	0.358 NS

NS = non significant

Tab. III. Oxytocinase levels in pregnancies according to maternal diseases

Maternal Diseases	APGAR score at the first minute		
	0 - 6 $\bar{x} \pm SD$	7 - 10 $\bar{x} \pm SD$	"t" value
Diabetes	6.17 mg β Naft $\pm$ 3.75 n = 6	8.27 mg β Naft $\pm$ 3.11 n = 8	1.107 NS
Vascular Diseases	5.89 mg β Naft $\pm$ 3.28 n = 8	7.74 mg β Naft $\pm$ 3.23 n = 7	1.092 NS
Rh Isoimmunization	7.16 mg β Naft $\pm$ 4.07 n = 3	5.91 mg β Naft $\pm$ 2.50 n = 6	0.487 NS

NS = not significant

hormone and enzymatic levels were compared according to newborn vitality.

As the type of delivery was similar in both groups of newborns, it was assumed that neonatal depression was mainly due to inadequate fetal oxygenation during labor.

An association between low hCS levels and neonatal depression evaluated by the APGAR score at the first minute was found by several authors [5, 7], while others did not confirm the findings [2, 6].

Since hCS is synthesized by the trophoblast, lower levels of this hormone would indicate an impaired trophoblast function. Therefore, the fetomaternal exchange would be diminished. However, we did not find any association between newborn vitality and maternal hCS levels. This fact indicates that hCS levels are not a good index of placental trans-

fer functions. This is supported by the finding [4] that there are two different regions in the trophoblast, one with secretory function and the other mainly with an exchange function.

The same results were obtained when maternal oxytocinase levels were considered.

According to the fetoplacental unit concept [3], estriol levels would not only indicate fetal adrenal and placental endocrine functions, but also fetomaternal exchange. Our findings support this suggestion as in the whole study population as well as in each separate group of maternal diseases, depressed newborns were associated with significantly lower maternal serum estriol levels than vigorous neonates.

BASHORE [1] found similar results in pregnancies with vascular pathology.

As fetal weight was discarded as an influencing factor in maternal hormone levels by the corresponding correction of estriol values, our results

indicate the suitability of maternal serum estriol determinations to predict condition of the newborns in high risk pregnancies.

Summary

In order to find a reliable index of fetal wellbeing, maternal estriol, hCS and oxytocinase levels were related with condition of the neonate.

Fifty six high risk pregnancies were studied. Estriol and hCS were determined by specific radioimmunoassay and oxytocinase with a colorimetric method.

The condition of the newborn was evaluated by the APGAR score. Neonates were divided into two groups, depressed (APGAR score 0–6) and vigorous (APGAR score 7–10).

When the mean birthweights of both groups were statistically different, maternal estriol levels were corrected to avoid the influencing factor of newborn weight.

Mean maternal estriol level corresponding to vigorous newborns was 46.73 ng/ml. This value was statistically higher than that corresponding to the group of depressed newborns, which was 26.25 ng/ml (Fig. 1).

The mean birthweight of depressed infants (2,382.75 g) was statistically lower than that of the vigorous group (3,044.75 g).

The corrected mean maternal estriol values of vigorous neonates (45.44 ng/ml) was different from that of depressed ones (25.14 ng/ml) (Fig. 2). When patients were divided according to maternal diseases (diabetes, vascular pathology, Rh sensitization) serum estriol levels of the mother were statistically different according to the Apgar score of the newborns.

There was no significant difference between serum hCS and oxytocinase levels of mothers with depressed and vigorous newborns.

Discarding fetal weight as an influencing factor in maternal hormone level, our results indicate the suitability of maternal serum estriol determinations to predict condition of the newborns in high risk pregnancies.

Keywords: APGAR score, birthweight, depressed neonates, high risk pregnancies, serum estriol, serum hCS, serum oxytocinase, vigorous neonates.

Zusammenfassung

HCS, Östriol und Oxytozinase im mütterlichen Serum und Zustand der Neugeborenen bei Risikoschwangerschaften.

Zu dem Zweck, einen zuverlässigen Index für das fetale Wohlbefinden zu erhalten, wurden Östriol, HCS und Oxytozinase im mütterlichen Serum in Beziehung zu dem Zustand der Neugeborenen gebracht.

56 Risikoschwangerschaften wurden beobachtet. Östriol und HCS wurden durch spezifische Radioimmunoassays und Oxytozinase durch eine kolorimetrische Methode bestimmt.

Der Zustand des Neugeborenen wurde klinisch nach dem Zahlenstatus nach APGAR bewertet. Die Neugeborenen wurden in zwei Gruppen eingeteilt: die im Depressionszustand (APGAR score 0–6) und die lebensfrischen (APGAR score 7–10).

Wenn die Geburtsgewichte beider Gruppen statistisch unterschiedlich waren, wurden die mütterlichen Östriol-Spiegel ausgeglichen, um den beeinflussenden Faktor des Neugeborenen-Gewichts zu vermeiden.

Der mütterliche durchschnittliche Östriolspiegel betrug bei den lebensfrischen Neugeborenen 46,73 ng/ml. Dieser

Wert war statistisch höher als der der Gruppe der Neugeborenen im Depressionszustand: 26,25 ng/ml (Abb. 1).

Das durchschnittliche Geburtsgewicht der Kinder im Depressionszustand (2 382,75 g) war statistisch niedriger als das der lebensfrischen Gruppe (3 044,75 g).

Die korrigierten durchschnittlichen mütterlichen Östriol-Werte bei lebensfrischen Neugeborenen (45,44 ng/ml) waren höher als bei denen im Depressionszustand (25,14 ng/ml (Abb. 2). Wurden die Patientinnen nach den mütterlichen Krankheiten (Diabetes, Gefäßkrankheiten, Rh-Sensibilisierung) eingeteilt, waren die Östriol-Serum-Spiegel der Mütter statistisch je nach dem Apgar score der Neugeborenen verschieden.

Zwischen dem HCS- und dem Oxytozinase-Spiegel der Mütter mit deprimierten und lebensfrischen Neugeborenen bestand kein bemerkenswerter Unterschied.

Abschließend wird festgestellt, daß zwischen dem fetalen Gewicht und den mütterlichen Hormonspiegeln ein Zusammenhang besteht. Unsere Ergebnisse zeigen außerdem die Tauglichkeit der mütterlichen Östriolbestimmung, um den Zustand der Neugeborenen bei Risikoschwangerschaften vorauszusagen.

Schlüsselwörter: APGAR score, Depressionszustand, Geburtsgewicht, Neugeborenes, Östriol, Oxytozinase, Risikoschwangerschaft.

Résumé

SCh, Estriol et oxytocinase du sérum maternel et condition néonatale dans les grossesses à haut risque

En vue de trouver un indice sûr du bien-être foetal, nous avons mesuré l'estriol, la SCh et l'oxytocinase maternels en rapport avec la condition du nouveau-né.

L'étude a porté sur 56 grossesses à haut risque. L'estriol et la SCh ont été évalués par radioimmunoessais et l'oxytocinase par méthode colorimétrique.

La condition des nouveaux-nés a été établie par le score APGAR. Les nouveaux-nés ont été répartis en deux groupes, l'un immature (score APGAR 0-6), l'autre mature (score APGAR 7-10).

Si les poids de naissance moyens dans les deux groupes ont été statistiquement différents, on a corrigé les degrés d'estriol maternel pour éviter le facteur influent du poids du nouveau-né. Le degré moyen d'estriol maternel correspondant aux nouveaux-nés matures a été de 46,73 ug/ml. Cette valeur a été statistiquement plus élevée que dans le groupe immature (26,25 ug/ml) (fig. 1).

Le poids de naissance moyen des nouveaux-nés immatures (2,382,75 g) a été statistiquement inférieur à celui du groupe mature (3.044,75 g).

La valeur moyenne corrigée d'estriol maternel chez les nouveaux-nés matures (45,44 ng/ml) a différé de celle des immatures (25,14 ng/ml) (fig. 2). Les patients ayant été répartis selon les diverses maladies maternelles (diabète, pathologie vasculaire, sensibilisation Rh), les degrés d'estriol du sérum maternel ont été statistiquement différents d'après le score Apgar des nouveaux-nés.

On n'a relevé aucune différence significative entre les degrés de SCh et d'oxytocinase du sérum des mères de nouveaux-nés matures et immatures.

Ecartant le poids foetal comme un facteur influent le niveau hormonal maternel, nos résultats nous autorisent à recommander la mesure d'estriol du sérum maternel pour préciser le pronostic de la condition des nouveaux-nés dans les grossesses à haut risque.

Mots-clés: Estriol du sérum, grossesses à haut risque, nouveaux-nés immatures, nouveaux-nés matures, poids de naissance, SCh du sérum, score APGAR.

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