Stress Hormones and Acid-Base Status in Human Fetuses at Term Delivery: The Effect of Delivery Method

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Abstract

To evaluate the effect of delIvery mode on fetal stress hormones and acid-base status and also to ravestlgate the relationship between fetal acldemia and these hormones,64 women with term pregnancies were studied All had singleton, healthy pregnancies Twenty one women were delivered by spontaneous vaginil route, 23 by vaginal route following oxytocin Infusion and 20 by elective caesarean section. Umblical cord blood samples were obtained immediately following the delivery. Blood gas (pH, pCO2, pO2) and hormonal analysis (Cortisol, dehydroepiandrosterone sulphate, prolactin, androstenedione) were done in arterial and venous cord blood samples respectively. Higher p02 and prolactin, lower pH levels were found in caesarean section compared to other two groups ($p<0.05$). At the time of delivery 11 infants had acidemla (pH <7.20) as judged by pH of umblical arterial blood. Acidemic group had higher cortisol and pCO2; lower pH and p02 levels compared to non-acidemic group ($p<0.05$). Method of delivery may affect acid-base and hormonal status of human fetus. Fetalacidemia may alter fetal adrenal steroidogenesis leading to increased fetal cortisol production (JPMA 46:123,1996).

Introduction

The estrogen synthesis from the placentae is regulated by some precursors such as dehydroepiandrosterone sulphate (DEAS). In conditions which cause chronic fetal distress, the blood and urine levels of DEAS decrease, whereas, cortisol (C) increases[1-4]. Chronic stress influences the fetal adrenal steroidogenesis and leads to reduction hi estrogen levels[5]. Conversely, it has been reported that, chronic fetal distress resulted in the increase of corticotropin releasing hormone (CRH), but the level of C did not change[6]. Fetal DEAS decreases and CRH increases in fetuses with intrauterine growth retardation[7]. In intrauterine fetal death cases due to pregnancy complications such as, Rh incompatibility, preeclampsia or diabetes mellitus the maternal estrogen levels decreased and morphological criteria of fetal adrenal suppression were demonstrated by pathologic examination[8]. Challis et al[9] showed that fetal C levels increase with hypoxiaatneartermsheeps. Thoughprolactinis considered as a stress hormone in adults, it was not investigated in fetuses adequately[10].
In this study, the relationship between the fetal acid base status, stress hormones and the route of delivery were investigated.

Subjects and Methods

The study group consisted of 64 healthy women with term pregnancies. All had singleton pregnancies and no fetal distress fmdings by cardiotocographic evaluation. Twenty one women were delivered by spontaneous vaginal route, 23 by vaginal route following oxytocin infusion and 20 by elective caesarean section. Indications for caesarean section were previous caesarean section in 11, cephalopelvic disproportion in 7, transverse lie in 1 and brow presentation in 1 case. All women had

clear amniotic fluid during the delivery. None except the caesarean group (CG) underwent any operative delivery method, such as vacuum or forceps application.
General anesthesia in CO and local perineal anesthesia in spontaneous vaginal groups (SVG) and oxytocin group (00) were used during the delivery. No woman had received any corticosteroid treatment before the delivery.
Umblical cord blood samples were obtained inunediately following the delivery. Arterial cord blood was collected in a 1 ml hepãrinized plastic syringe for the measurement of acid-base status (pH, pCO2, p02) within 30 minutes using a Radiometer Copenhagen ABL 4 blood gas analyser. 10 nil venous cord blood samples were obtained for honnonal analysis 10ml venous cold blood samples were obtained from hormonal analysis [C, DEAS, prolactin (PRL), androstenedione (A) in a non-heparinized syringe and centrifuged at 1800rpm for 10 minutes. After centrifugation supernatant was collected and stored at -20o C until analysis. Radioimmunoassay method was used for all hormonal measurements. The co-efficient of variations of the intrassay and intra-assay variability for C,A,PRL and DEAS measurements were 8.4% and 9.1%, 4.3% and 6% and 7.1%, 6.3% and 9.9% respectively. The data were analyzed using unpaired t Test, analysis of variance and correlation regression analysis in SPSS for windows 5.0 by IBM compatible PC.

Results

Mean gestational weeks of women were 39 4+ 0.45, 39.95+ 0.69 and 38.7+ 0.97 weeks in SVG, OG and CG respectively (p>0.05). Twenty one of them (32.8%) were nulliparous, the other 43 (62.2%) multiparous. Active phase duration of labour were 4.57+ 1.98, 4.95+ 2.01 hours in SVG and OG respectively (p>0.05). Mean birth wait in CG (3657+387 g) were significantly higher than those of SVG (3161.9+461 g) and OC (3369+565 g,p<0.05) \'(Mean+SD).
The ages of women, blood gases and hormonal values are shown in Table 1.

Table I. Ages of women, blood gases and hormones.

Type of Delivery	Age	pH	pCO2 (mm Hg)	pO2 (mm Hg)	DEAS (µg/ml)	C (µg/dl)	DEAS/C	A (ng/ml)	PRL (mIU/L)
SVG (n=21)	25.57±4.88	7.28±0.07	47.96±10.31	15.48±4.80	262.06±89.5	14.55±6.27	21.74±12.38	4.90±1.78	86.25±27.53
OG (n=23)	26.45±3.50	7.26±0.06	48.59±8.59	18.51±6.21	286.94±108.3	15.20±10.09	25.90±18.20	5.32±1.76	90.42±21.05
CG (n=20)	27.85±5.44	7.32*±0.06	44.22±8.99	19.60*±4.50	286.63±108.8	13.90±10.20	33.50±23.62	4.81±1.57	103.59*±9.43

*P<0.05 2±21.0

Cord blood pH values were significantly lower in SVG and OG compared to CG (p).pO2 values were significantly higher in CG than SVG (p<0.05). PRL levels showed a significant increase in CG compared to SVG and OG (p<0.05), There was no significant difference among the other hormone levels of above three groups.
DEAS/C ration showed slight but insignificant increase in CG compared to other two groups (p<0.05).
Bicarbonate (HCO3) levels showed no difference among three groups (p>0.05).
pH and PO2 were significantly lower, pCO2 and C significantly higher in acidemic compared to non acidemic group (p<0.05) (Table II).

Table II. Sub-groups according to cord blood pH levels.

Sub-groups	Age	pH	pCO2 (mm Hg)	pO2 (mm Hg)	DEAS (µg/ml)	C (ug/dl)	DEAS/C	A (ng/ml)	PRL (mIU/L)
AG (n=11)	27.36±3.44	7.16*±0.05	58.8*±11.04	14.63*±4.64	261.03±1 8.21	20.24*±1 .91	18.26±16.33	5.38±1.72	89.70±26.51
NAG (n=53)	27.15±5.19	7.30±0.04	44.57±6.88	18.52±5.42	282.34±9(40	13.41 .7.50	28.70±18.98	4.95±1.70	93.89±20.92

*P<0.05

Gestational weeks, birth weights HCO3 levels and other hormonal values showed no significant difference between acidemin and non-acidemic groups (p>1.05). Statistically signnificant correlations for the whole group;the relationship between C and DEAS levels are shown in Table III and Figure respectively.

Table III. Relationship between cortisol and DEAS.

SVG	DEAS	pCO2	PRL		
		-0.44	0.45		
OG		C	DEAS	pCO2	
	pH	-0.56	-0.57	-0.69	
	pCO2	0.60			
CSG		C			
	DEAS	0.46			
AG		HCO3			
	DEAS	0.74			
NAG		A	pCO2	DEAS	
	pH	-0.38	-0.47	0.28	
	C			-0.32	
Total Group	pH	A	C	DEAS	pO2
	C	-0.33	-0.28	0.26	
				-0.29	-0.26

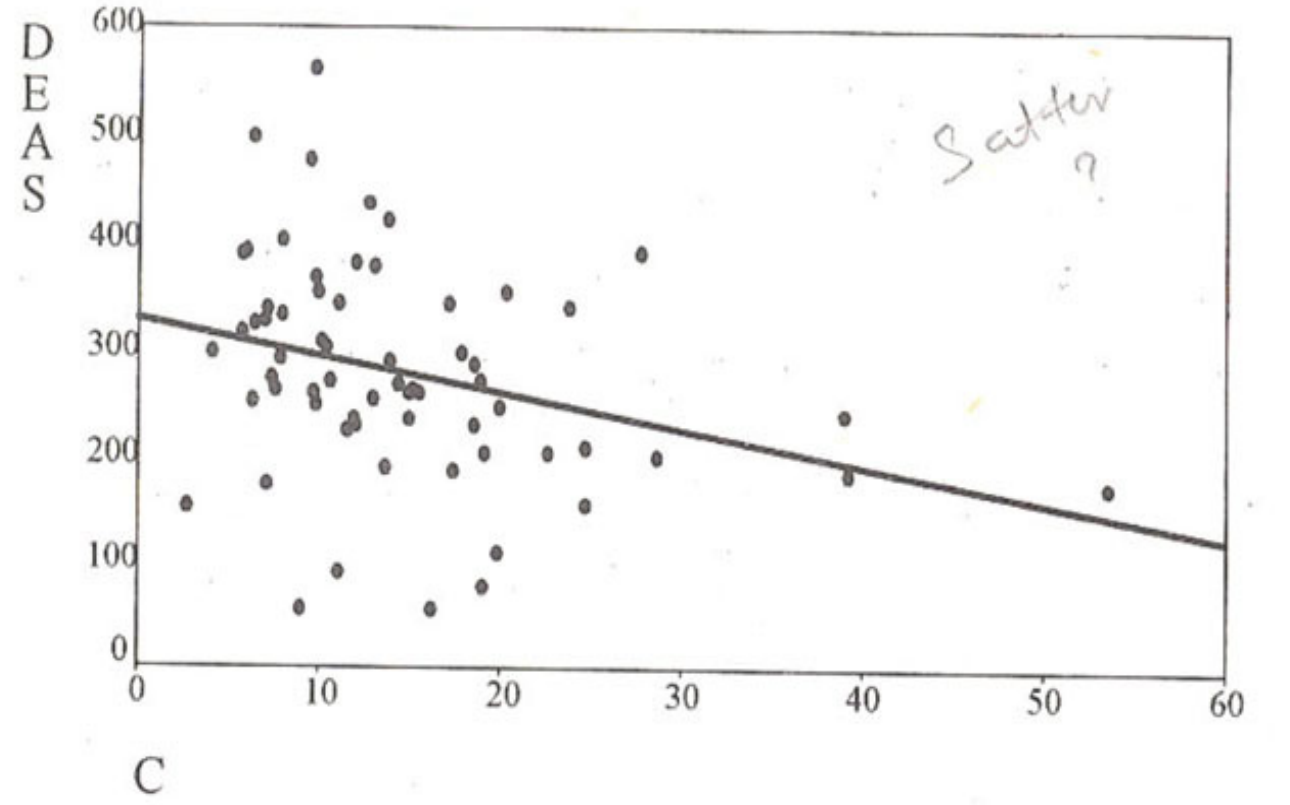

Figure. Correlation between DEAS and C in total groups (r= -0.29, p<0.05)

The study groups (Table II) were divided into two subgroups according to coni blood pH levels; the acidemic group (AG) and non-acidemic group (NAG). Cord blood pH levels were pH.<7.2 inAG an >7.2 in NAG. Elevencases had fetal acidemia. One of them had metabolic (pCO2<65 mmHg and HCO3 <17 mEqfL), 2 had respiratory (pCO_265 mmHg and HCO3_17 mEq/L), Shad mixed fetal acidernia(pCO2<65 mmHg and HCO3>17 mEq/L). One with metabolic acidemia was in CG, 2 with respiratory acidemia in SVG. Of the 8 cases with mixed acidemia, 6 were in OG, 1 in SVG and 1 in CG.

Discussion

The adrenocorticotropic hormone (ACTh) is detectable in the fetal pituitary by 8 weeks and act on the adrenal cortex, potentiating growth of the fetal zone in the adrenal gland[11]. The adrenals are responsible forbiosynthesis and secretion of glucocorticosteroids by the inner fetal zone and for the production of adrenal androgens by the adult zone of the fetal cortex. Because of the fetal adrenals inability to convert pregnenolone to progesterone, progesterone must come from some exogenous sowve. Progesterone synthesized by placenta is then transported to the fetus; fetal zone preferentially converts progesterone to corticosteroids[12].

Remin[13] and Parker[14] reported that, the C levels to be higher in the group who delivered vaginally compared to the caesarean section group. Hercz et al[15] have found elevated C and DEAS values in the group who delivered by vaginal route

This study could not demonstrate any difference between these two groups related to the C and DEAS levels.The mean duration of active phase in the group who delivered vaginally (spontaneous+oxytocin

induction) was relatively short (4.71±1.99 hours) in the present study; There is no data related to the duration of labor in Ramin's[13] and Parker's[14] studies. In this study, no relation between the duration of labour, hormone profiles and blood gas levels was detected.

In the present study, the cord blood PRL values were higher in CG in comaparison with the other two groups ($p<0.05$). Ramin et al[13] reported that PRL values are higherin CO than the group who delivered vapnally but this was not statistically significant. Sadowsky' showed a significant increase in fetal C levels with oxytocin infusion in pregnant sheep. This finding suggests an alteration in fetal adrenal functions by myometrial activity. We did not detect any difference of C levels between the oxytocin and other two groups. Cord blood p02 levels were found to be significantly lower in oxytocin infused group than in non-infused group16. Conversely, in this study, the p02 levels were relatively higher in SVG than in 00 but this was not statistically significant.

The relationship between oxytocin infusion and fetal acidemia was investigated by some authors but no difference was found in cord blood pH values between the oxytocin infused and non-infused groups[17]. In this study, the arterial cord blood pH was relatively low in the oxytocin infused group than the non-infused group, but it was not statistically significant (Table I).

When the cases were divided as acidemic and nonacidemic subgroups, a significantly higher C and lower but insignificant DEAS levels were observed in acidemic group (Table II). Challis[18] demonstrated a progressive and long-term increase in cord blood C levels in hypoxic, acidemic conditions by decreasing the uterine blood flow of pregnant sheep. Some authors reported that fetal C increases but PRL and DEAS remain stable in acidernia[13-14]. But in a recent expenmental study, PRL and C levels were the same while DEAS and A showed acute increase with hypoxia[19]. Inthis study pO2 was significantly low and A was relatively high in acidemic group althoughlatterwas not statistically significant The high level of C in acidemic group corresponded with the literature[13,14,19] it was reported that PRL is one of the stress hormones in adults[10]. However, results of this study did not indicate that PRL is a stress hormone other than a positive correlation with DEAS in the group who delivered spontaneous vaginally.

The high level of fetal cord blood pH and p02 in CG suggest that the route of delivezy may affect the blood gases. In acidemic, hypoxic cases, the cord blood C levels increase significantly and DEAS decrease relatively. The positive relation between the pH and DEAS and negative relation between the pH and C supports this idea. The hormonal profile of fetal adrenals alters in stress conditions. The negative relation between the C and DEAS is noticeable in this alteration. Further extensive studies are needed to clarify this subject.

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