BRIEF NOTES AND COMMENTS

Intravenous Glucose Tolerance Test in Pregnancy in Women Living in Chronic Hypoxia

Rolando Calderón, M.D., L. Alberto Llerena, M.D., Leopoldo Munive, M.D., and Francisco Kruger, M.D., Lima, Peru

SUMMARY

Rapid intravenous glucose tolerance tests have been performed in women living at high altitude in an environment of chronic hypoxia (average values: barometric pressure 445 mm. Hg, alveolar *p*02 46.0 mm. Hg, arterial *p*02 45.1 mm. Hg). The hypoxic group had a curve of the same shape but with lower values when compared with that of women born and living at sea level.

At sea level pregnancy modified the curve obtained when compared with that of nonpregnant women, but at high altitude pregnancy did not modify the curve. As a possible explanation a higher basal level of insulin in the high altitude group is suggested. DIABETES *15*:130-32, February, 1966.

Previous studies from our laboratory have shown that in men born and living at high altitudes, values obtained during intravenous glucose tolerance tests, when compared with those of men born and living at sea level, are lower at all points.[1] The influence of pregnancy on carbohydrate metabolism in normal women, without a family history of diabetes or an unfavorable obstetrical record, is to lower the fasting level of blood glucose and to improve the glucose tolerance.[2] Therefore, we have examined what effect pregnancy might have on the glucose tolerance of women born and living at high altitudes in an environment of chronic hypoxia.

MATERIALS AND METHODS

Four groups of women were studied. They were comparable in age (eighteen to forty years) and in height and weight.

Group I. Nineteen normal nonpregnant women born and living at sea level.

Group II: Thirteen normal nonpregnant women born and living at high altitude.

Group III: Twenty-one third trimester pregnant women born and living at sea level.

Group IV: Twelve third trimester pregnant women born and living at high altitude.

No women with a positive family history of diabetes were included, nor were women with an unfavorable obstetrical record (abortion, intrauterine deaths, neonatal mortality, preeclampsia and babies with a weight over 4 kg.) inasmuch as these factors have been regarded as precursors of frank diabetes.[3]

After an overnight fast a sample of venous blood was taken. Through a different antecubital vein, 40 ml. of a 50 per cent solution of glucose were injected in a period of two minutes. Samples of venous blood were collected every fifteen minutes for an hour in flasks containing oxalate and fluoride. The studies at high altitude were performed at the mining town of Cerro de Pasco at an altitude of 14,900 feet (average values: barometric pressure 445.8 mm. Hg, alveolar *p*02 46.0 mm. Hg, arterial *p*02 45.1 mm. Hg). Blood glucose was determined by the Somogyi-Nelson method.[4]

RESULTS

The results are shown in tables 1, 2 and 3.[5] The studies in nonpregnant women showed (table 1) that those in the high altitude group had a curve of the same shape but lower at all its points than that of women born and living at sea level. At sea level a lower fasting level of glucose was observed in pregnant than in nonpregnant women and the curve was statistically lower at fifteen and sixty minutes (table 2).

In the high altitude group pregnancy did not modify significantly the intravenous glucose tolerance test (table 3). Although all values for pregnant women were lower than those for nonpregnant subjects, the differences were not significant except possibly in the fasting state.

It is noteworthy that if the values from pregnant women at sea level are compared with the values obtained in nonpregnant women at high altitude no differences are observed.

DISCUSSION

The finding of a low normal level of fasting blood glucose during pregnancy has been reported before. Thus, Wilkerson and O'Sullivan[6] in a study of 752 unselected pregnancies found a fasting blood glucose of 69.3 mg. per 100 ml. which agrees with the figure herein reported. There is no clear explanation for this fact. In a recent review on the subject of insulin homeostasis during pregnancy, Freinkel[7] suggests that an increase in the production of endogenous insulin is necessary to maintain a normal glucose tolerance during pregnancy. The histologic finding of hyperplasia of beta cells during normal pregnancy[8,9] and the higher fasting level of plasma insulin, found by Leake and Burt[10] and by Spellacy and Goetz[11] are in keeping with this observation.

From the Instituto de Investigaciones de la Altura, Universidad Peruana "Cayetano Heredia," P.O. Box 6083, Lima, Peru.

TABLE 1
Intravenous glucose tolerance test in nonpregnant women

Time in minutes			Mean	S.E.M.	S.D.	Δ	S.E.D.	p.
Basal	Sea level	(19)*	85.9†	1.7	7.5	14.2	2.3	.001
	High altitude	(13)	71.7	1.5	5.2			
15	Sea level	(19)	179.2	7.2	30.4	28.9	9.6	<.01 >.001
	High altitude	(13)	150.3	6.4	22.0			
30	Sea level	(19)	101.5	7.8	32.9	12.6	9.9	No S.
	High altitude	(13)	88.9	6.2	21.3			
45	Sea level	(19)	83.6	8.2	34.5	17.5	9.3	No S.
	High altitude	(13)	66.1	4.5	15.4			
60	Sea level	(19)	72.8	3.2	13.6	10.5	4.1	<.02 >.01
	High altitude	(13)	62.3	2.6	9.2			

*Figures in parentheses indicate number of subjects. †All values in venous blood glucose mg. per 100 ml.

TABLE 2
Intravenous glucose tolerance test in pregnancy at sea level

Time in minutes			Mean	S.E.M.	S.D.	Δ	S.E.D.	p.
Basal	Nonpregnant	(19)*	85.9†	1.7	7.5	16.6	2.7	.001
	Pregnant	(21)	69.3	2.2	9.5			
15	Nonpregnant	(19)	179.2	7.2	30.4	24.3	8.8	.01
	Pregnant	(21)	154.9	5.2	22.0			
30	Nonpregnant	(19)	101.5	7.8	32.9	3.7	8.9	No S.
	Pregnant	(21)	97.8	4.3	18.1			
45	Nonpregnant	(19)	83.6	8.2	34.5	16.5	9.3	No S.
	Pregnant	(21)	67.1	4.4	18.7			
60	Nonpregnant	(19)	72.8	3.2	13.6	11.1	4.3	.01
	Pregnant	(21)	61.7	2.9	12.4			

*Figures in parentheses indicate number of subjects. †All values in venous blood glucose mg. per 100 ml.

TABLE 3
Intravenous glucose tolerance test in pregnancy at high altitudes

Time in minutes			Mean	S.E.M.	S.D.	Δ	S.E.D.	p.
Basal	Nonpregnant	(13)*	71.7†	1.5	5.2	7.4	3.0	<.02 >.05
	Pregnant	(12)	64.3	2.6	8.8			
15	Nonpregnant	(13)	150.3	6.4	22.0	6.5	8.7	No S.
	Pregnant	(12)	143.8	5.9	19.5			
30	Nonpregnant	(13)	88.9	6.2	21.3	7.3	9.3	No S.
	Pregnant	(12)	81.6	7.0	23.1			
45	Nonpregnant	(13)	66.1	4.5	15.4	5.5	6.8	No S.
	Pregnant	(12)	60.6	5.1	16.8			
60	Nonpregnant	(13)	62.3	2.6	9.2	5.8	4.5	No S.
	Pregnant	(12)	56.5	3.7	12.3			

*Figures in parentheses indicate number of subjects. †All values in venous blood glucose mg. per 100 ml.

It is necessary to have in mind the role played by the placenta and the conceptus in the metabolism of this excess of insulin. The simultaneous determination of insulin levels in maternal and fetal blood has shown that this level is higher in the maternal blood[12] and Buse, Roberts and Buse[13] have not been able to show an accumulation in the fetal blood of the radioactive insulin administered to pregnant women hours before delivery suggesting that the placenta acts as a barrier for insulin. On the other hand, in pregnant rats, Goodner and Freinkel[14] have shown that there is an acceleration in the catabolism of insulin.

Our findings in the sea level group show, in agreement with other reports,[2] that pregnancy is associated with an increase in glucose tolerance. Nonpregnant women from the high altitude group had a curve of the same shape but with lower values than nonpregnant women from the sea level group, but, except for a minor decrease in the fasting level of glucose, pregnancy in the high altitude group did not introduce any change in the intravenous glucose tolerance test. Inasmuch as it has been shown that the blood sugar changes observed in pregnancy are associated with an augmentation in the secretion of insulin, one could speculate that pregnancy in the high altitude group may not be associated with increased insulinogenesis—however a diminished responsiveness to endogenous insulin release cannot be excluded—though we have shown that men from a high altitude environment retain the capacity to respond to intravenous tolbutamide.[1] It is interesting to observe that the curves obtained in pregnant women at sea level are almost identical to the curves obtained in nonpregnant women in the chronic hypoxia group.

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