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Human Placental Lactogen – Physiological Role in Pregnancy

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HUMAN PLACENTAL LACTOGEN (HPL) is a polypeptide hormone of molecular weight 19,000. It is produced by the syncytiotrophoblast of the placenta (Josimovich and Atwood, 1964; Josimovich et al, 1969; Sciarra et al, 1963). It is secreted mainly into the maternal circulation, into the intervillous space and maternal blood pool and to a lesser extent into the fetal compartment (Josimovich, 1968; Josimovich and Atwood, 1964; Kaplan and Grumbach, 1965). Very little therefore reaches the fetal compartment. It is believed therefore that the effect of HPL is mainly on the maternal organism and not on the fetus.

HPL Trends in Pregnancy

HPL has been detected as early as six weeks pregnancy using radioimmunoassay methods (Hart, 1971). From six weeks to 36 weeks of gestation, there is a steady rise in HPL values, this rise being parallel to the placental growth curve (Josimovich, 1969). From 36 weeks to 40 weeks, placental growth continues to increase while a plateau in mean HPL values occurs. Following delivery, the hormone is cleared rapidly from the maternal circulation; its half-life being about 20 minutes (Hart, 1971).

Control of HPL Secretion

Investigators have shown that HPL levels have no relationship to maternal age and parity, maternal activity, fetal sex, fetal abnormality, diurnal status, or to use of oestrogens and progestogens in pregnancy.

(i) **Placental Mass**

There appears to be a significant correlation between active placental mass and HPL levels before 36 weeks of gestation (Josimovich et al, 1969). Investigations indicate that HPL secretion does not determine placental size but rather that placental size seems to determine the amount of HPL produced during pregnancy.

(ii) **Fetal Weight**

A lower but statistically significant correlation exists between HPL mean values and fetal weight. High HPL values are expected to be seen with multiple pregnancies (Spellacy, 1973; Spellacy et al, 1971).

(iii) **Maternal Blood Glucose Levels**

Since HPL resembles the human growth hormone in some of its biological effects, it was thought that variations in maternal blood glucose levels might affect HPL secretion. Samaan et al (1966) showed that no relationship between HPL secretion and maternal blood glucose levels exists and Spellacy et al (1971) pointed out that any change in HPL secretion in this respect was small.

(iv) **Fetal Glucose Levels**

Dawes (1968) raised the possibility of fetal glucose alterations affecting HPL secretion. No data is available, presently, on this aspect of HPL control.

Biological Effects of HPL in Pregnancy

The physiological role of HPL is not yet clearly understood. That its biological effects have not been finally determined can be judged by its varied terminology. The hormone has been referred to

as Chorionic Growth-hormone – Prolaction (CGP) (Sciarra et al, 1963), Human Chorionic somatomammotropin (HCS) (Li et al, 1968), and purified placental protein.

(i) **Lactogenic Role**
This has been suggested because HPL has pronounced lactogenic effects on experimental lower animals (Josimovich and MacLaren, 1962). In pigeon crop assays, the hormone is 30 per cent as active as pituitary prolactin.

In mice, HPL accelerates casein synthesis in mammary tissue. It is logical therefore to suggest a possible role of HPL in the preparation of the breasts for early lactation.

(ii) **Growth-hormone-like Effects**
One cannot ignore this fact that HPL levels in maternal blood at term are 100 times over what human growth hormone levels ever reach (Kaplan and Grumbach, 1964). HPL has been shown to potentiate the actions of growth hormone (Josimovich and Atwood, 1964); and like growth hormone, HPL promotes nitrogen retention, increased mobilisation of free fatty acids, potassium retention and decreased glucose tolerance. It is likely that HPL has an important influence on fetal growth.

(iii) **Glucose-sparing for Fetal needs**
HPL brings about decreased maternal glucose tolerance by increasing maternal resistance to endogeneous insulin; and this metabolic change spares glucose for fetal needs at the time of its greatest growth (Spellacy and Goetz, 1963). This glucose-sparing action is supplemented by increased insulinase activity in the placenta and maternal liver during pregnancy, and also by the increased levels of blood oestrogen and progesterone in pregnancy (Spellacy et al, 1968). How important this effect is still remains to be seen.

(iv) **Promotion of Steroidogenesis**
A fundamental role of HPL is in the promotion of steroidogenesis in the pregnant mother (Josimovich, 1968; Josimovich et al, 1963). This is because HPL helps human chorionic gonadotrophin in maintaining a balanced production of progesterone and oestrogen. In addition, HPL has a limited luteotrophic effect of its own. It is also said to aid the maintenance of the decidual changes in pregnancy.

(v) **Erythropoietic Role**
HPL has been shown to augment the action of erythropoietin on erythropoiesis in mice (Jepson and Friesen, 1968). For this action of HPL, endogeneous production of erythropoeitin is essential. This is because HPL does not stimulate production of erythropoietin.

The importance of this observation would be in the erythropoietic capacity of this hormone to enhance the acceleration of erythropoiesis during pregnancy.

(vi) **Aldosterone Production**
An increase in aldosterone production by the adrenal cortex has been associated with the experimental use of highly purified HPL in human beings (Melby et al, 1966). HPL induced an average increment of 30 per cent in aldosterone secretion on normal sodium intake and it is possible that the hypersecretion of aldosterone in pregnancy results from this stimulation.

(vii) **Diabetogenic Activity**
Just as the other diabetogenic agents, HPL might be responsible for exacerbation of diabetes in pregnancy (Lancet-leading article, 1969). This is because this hormone, when administered to stable diabetics, increases glycosuria and fasting blood sugar levels and further impairs glucose tolerance (Samaan et al, 1968).

Conclusion

The important functions of HPL probably centres around the preparation for lactation, the sparing of glucose for fetal needs and the promotion of steroidogenesis. Which of these functions is the primary role of HPL remains to be determined. Nevertheless though the physiological role is still uncertain, because of its diverse biological effects, HPL must play some important role in the feto-maternal physiology of pregnancy.

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