measured the genes controlling their expression were functioning as early as 40 days' gestation. Detection of hereditary disorders related to these enzymes could theoretically be accomplished as early as five weeks.

Human placental barrier to glucagon-I-125 early in gestation. P. ADAM, K. KING, R. SCHWARTZ, and K. TERAMO. *Case Western Reserve Univ. Sch. Med. at Cleveland Metro. Gen. Hosp., and Univ. Helsinki, Central Hospital, Helsinki, Finland.*

Studies of hormonal transfer have shown that the human placenta is impervious to 2 labeled polypeptide hormones-insulin and human growth hormone; but the transfer of glucagon, a polypeptide hormone of lower molecular weight, has not been evaluated previously in pregnant human subjects. Although its placental transfer has been demonstrated in other species, the results are confusing because of the non-specific methodology used. In order to determine whether the human placenta permits maternofetal transfer of glucagon, nine pregnant women at 15 to 17 wks of gestation were evaluated during legal therapeutic abortions by abdominal hysterotomy. The plasma concentration of glucagon-I-125 was maintained until delivery of the fetus by continuous intravenous infusion of the labeled hormone at the following rates: 20 μc/hr for 3–4 hrs in 4 women; and 60 μc/hr for 1 to 1.5 hrs in the other 5. The plasma concentration of the labeled glucagon was measured by a *specific* immunoprecipitation. Even with maternal plasma concentrations of radioactive glucagon between 599 and 1289 cpm/ml, no glucagon-I-125 was detected either in the umbilical venous or arterial plasma, or in the amniotic fluid. Early in gestation, therefore, the human placenta is an effective barrier to the rapid maternofetal transfer of glucagon-I-125. Based on this concept, regulation of the fetal plasma glucagon levels would depend on its secretion by the fetal rather than the maternal pancreas.

The placental calcium pump. INGEBORG C. RADDE, YEHEZKEL SHAMI, and DAVID K. PARKINSON. *Univ. of Toronto and Hosp. for Sick Children, Toronto, Ont., Canada* (Intr. by Andrew Sass-Kortsak).

During fetal life an uphill gradient for calcium ions exists between maternal and fetal circulations (maternal Ca^{2+} 1.95 mEq/l, fetal Ca^{2+} 2.45 mEq/l). We postulate that this gradient is maintained by an active transport system for calcium ions, similar to the calcium pump in renal tubular and intestinal mucosal plasma membranes. To characterize the enzyme, placental plasma membranes from guinea pigs were prepared according to the method of Post and Sen (Methods Enzymol. 10: 762, 1967). Samples were incubated for 30 min at 37 C in solutions containing 70 mM Na^+, 20 mM Tris (pH 7.6), Ca^{2+} or Mg^{2+} or both, in concentrations varying from 0.025 mM to 20 mM, and 5 mM Na_2ATP. P_i and protein were determined and results expressed as umole P_i released per mg protein in 30 min. Ca^{2+} in the absence of Mg^{2+} stimulated P_i production. Mg^{2+} in the absence of Ca^{2+} also stimulated the enzyme but to a lesser degree. 5 mM Ca^{2+} produced maximal stimulation (15–25 μmole P_i/mg protein in 30 min). Mn^{2+}, but not Sr^{2+}, stimulated P_i production, as with other Ca^{2+} ATPases (renal, intestinal mucosal). The pH optimum was 8.2; at 7.2 and 9.5 the enzyme activity was 50% of the maximum. Ouabain (1 mM) was not inhibitory, but addition of increasing amounts of EDTA led to progressive loss of activity; total inhibition occurring at 5 mM EDTA. Further fractionation of samples with sucrose-gradient centrifugation doubled the specific activity of the enzyme in the plasma membrane fraction. We believe that this enzyme of the placental plasma membranes activates a calcium pump which maintains the gradient of calcium ions between maternal and fetal circulations and ensures normal calcification in the fetus.

Fetal malnutrition. T. YOSHIDA, A. BERNAL, J. METCOFF, A. ROSADO, P. YOSHIDA, J. URRUSTI, L. VELASCO, and S. FRENK. *Univ. Oklahoma Med. Ctr., Okla. City, Okla., and Centro Medico Nacional, IMSS, Mexico City, D. F., Mexico*

Many instances of intrauterine growth retardation may represent fetal intrauterine malnutrition (IUM) rather than "placental insufficiency". Clinical, physiologic, and biochemical features simulate those of protein-calorie malnutrition (PCM) of infants. Cell size (protein/DNA) often is increased in IUM, but its relation to energy functions of the cell is uncertain. The present studies explored whether patterns of cell energy metabolism in IUM resembled those found in PCM, and if these patterns were similar in fetal and placental cells. Energy charge (EC) = (ATP + ADP/AMP + ADP + ATP), pyruvic (PK) and adenylic kinase (AK) and energy capacity (EC_a) = AK (ATP + ½ ADP) of leukocytes isolated from cord blood and of placentas were related to cell size (protein/DNA). For 13 IUM infants, leukocyte cell size was increased. PK and AK activities were reduced, compared to 28 low weight but appropriately nourished premies (P) or 33 full term (FT) infants. Most, but not all, of the differences were statistically significant. EC of the IUM leukocytes was not decreased; ATP and EC_a were. For placentas, while total DNA and RNA were reduced in 20 IUM's, cell size and ribosomal mass (RNA/DNA) were increased compared to 17 FT and 10 P. AMP was the only nucleotide significantly decreased in IUM's. Placental AK and PK were increased and correlated with cell size and birth weight in IUM babies. While EC was slightly decreased in IUM placentas, EC_a was increased. Thus, energy metabolism of IUM leukocytes is like infants with PCM, and metabolic changes in placental cells differ from those found in the infant's leukocytes.

Oxygen (O_2) consumption as measure of cell number in intrauterine growth failure (IUGF). INGEBORG KRIEGER and P. V. WOOLLEY, JR. *Wayne State Univ. Sch. of Med., Detroit, Mich.*

O_2-cons. in the basal state is a measure of the metabolically active tissue mass and, as such, may reflect cell number rather than cell mass. This was tested by comparing conditions which have a different ratio between cell number and cell mass (CNo). 24 patients with IUGF and persistent linear growth failure after birth (PIUGF) were assumed to have a low CNo. 31 patients with growth failure of postnatal onset due to undernutrition, group A, were assumed to have a higher CNo than PIUGF because undernutrition in not rapidly multiplying tissues decreases cell size. 24 patients with growth failure of postnatal onset and congenital anomalies were placed in group B, with unknown relative CNo. Ages were 4/12–10 years and height ages <3 years. 37 normal controls were <3 years old.

O_2-cons. for age and height age was significantly lower in PIUGF than all other groups. O_2-cons. of groups A and B was not different, i.e. significantly lower than the normal for age and similar to the normal for height age. O_2-cons. per body weight was normal in PIUGF and elevated in groups A and B. O_2-cons. per weight predicted from height was negatively related to height in per cent of the normal height for age. The regression for PIUGF was significantly lower than in groups A and B. A good correlation was evident only in group A ($r = .723$). This suggests an increase in metabolically active tissue with increasing