



Turun yliopisto
University of Turku

FETAL HEART AND HEMODYNAMICS IN DIABETIC PREGNANCY

Fetal cardiac and placental function in a rat model of maternal hyperglycemia and human type 1 diabetic pregnancies

Lara Lehtoranta

ABSTRACT

Lara Lehtoranta

Fetal heart and hemodynamics in diabetic pregnancy - Fetal cardiac and placental function in a rat model of maternal hyperglycemia and human type 1 diabetic pregnancies

University of Turku, Faculty of Medicine, Department of Obstetrics and Gynecology
University of Oulu, Faculty of Medicine, Institute of Biomedicine, Physiology
Turku University Hospital, Department of Obstetrics and Gynecology
University of Turku Doctoral Program of Clinical Investigation

Annales Universitatis Turkuensis, Medica-Odontologica, 2017

Maternal type 1 diabetes mellitus affects fetal and offspring health. We aimed to investigate fetal cardiac and placental function in a rat model of maternal pregestational hyperglycemia, and the effect of gestational hyperglycemia on the offspring heart. In human fetuses of diabetic mothers the aim was to investigate, whether maternal insulin therapy will ameliorate fetal cardiac, hemodynamic, and placental abnormalities.

Fetal cardiac and placental ultrasonography, histology, and gene expressions were examined in streptozotocin-induced maternal hyperglycemia and control rats. Rat offspring cardiac genes and histology were analyzed up to two weeks after birth. In diabetic and healthy human pregnancies, fetal ultrasonography and biochemical markers of cardiac function and fetal hypoxemia, and placental morphology and gene expression were collected.

In rat fetuses of maternal hyperglycemia, signs of diastolic dysfunction persisted throughout the second half of pregnancy, and transient mid-pregnancy cardiac dysfunction was observed. Increased myocardial cell turnover with cardiac hyperplasia and abnormal myocardial gene expression patterns were found. Increased placental vascular impedance and placental morphologic abnormalities were observed in the rat fetuses of maternal hyperglycemia. In the newborn rats of maternal hyperglycemia, cardiac genes controlling contractility, growth, structure, and metabolism were differently expressed when compared to healthy newborn rats. In human diabetic pregnancies, fetal cardiac output was decreased, pulsatility of the aortic isthmus blood flow velocity waveform, and fetal serum concentrations of natriuretic peptides and troponin T were increased at near term.

The rat model shows that maternal hyperglycemia leads to diastolic dysfunction and placental insufficiency. Abnormal expression of genes involved in cardiac contractility, structure, growth, and metabolism were seen in late term fetal and offspring hearts. In human maternal diabetes, fetal cardiac output is decreased with biochemical evidence of myocardial dysfunction.

Keywords: type 1 diabetes mellitus, maternal hyperglycemia, pregnancy, fetal, heart, ultrasonography, streptozotocin, histology, cardiac output, impedance, hyperplasia, cardiac contractility, excess cardiac growth, cardiac output, erythropoietin, diastolic dysfunction, placental insufficiency