ABSTRACT

The placenta and the lungs are the only organs that perform a function of blood oxygenation and have a common characteristic - vasoconstriction in response to acute hypoxia. Thus the reaction is in an opposite manner than smooth muscle of systemic arteries does. In this study we focused on the mechanisms that regulate fetoplacental blood vessels in conditions associated with hypoxia. An experimental model of isolated dually perfused rat placenta was used.

Our findings demonstrate an essential role of Rho kinase signaling pathway in the mechanism of this hypoxic fetoplacental vasoconstriction (HFPV).

Chronic exposure to hypoxia causes a sustain elevation of vascular resistance on fetoplacental blood vessels. It was demonstrated in experiment with low-viscosity salt solution perfusion. Our current results show a significant increase of the fetoplacental vascular resistance with blood perfusion which better reflects in vivo conditions. An increase in fetoplacental vascular resistance may lead to placental hypoperfusion and consequent fetal undernutrition, which is considered one of the key causes of serious fetal and neonatal problems, especially intrauterine growth restriction.

Diabetes mellitus is a well-known factor affecting fetal growth. Both chronic hypoxia and diabetes act on vessels partly through redox alterations. The fetuses of diabetic mothers have a number of characteristics indicative of fetal hypoxia. However the effects of diabetes on the fetoplacental hemodynamics are not yet known. Our results show a significant increase of fetoplacental vascular resistance in diabetic mothers, not only due to vasoconstriction. Diabetes and chronic hypoxia together do not have an additive effect on fetoplacental vessel resistance which could indicate the involvement of similar mechanisms of the elevation of fetoplacental resistance and/or impairment of different sections (arterial or venous) of fetoplacental vascular bed in chronic hypoxia and diabetes.

Understanding the mechanisms of the effects of hypoxia on fetoplacental vessels thus might ultimately facilitate new treatments of impairments where chronic intrauterine hypoxia is involved.

Key words: placenta, hypoxic fetoplacental vasoconstriction, Rho kinase, hypoxia, intrauterine growth restriction, diabetes, oxidative stress