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Changes in hydrogen sulphide system in myocardium of rats with experimental diabetes

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Background: Diabetes mellitus and its complications increase the risk of cardiovascular morbidity and mortality, contributing to the damage of myocardium. Several mechanisms are proposed to understand the development of myocardial diabetic complications, including elevated oxidative stress, altered calcium homeostasis, activation of apoptotic signals, and reduction of angiogenesis. H2S is a gas transporter and is endogenously generated in cardiovascular system by cystathionine-γ-lyase (CSE, EC 4.4.1.1), 3-mercaptopyruvate sulfotransferase (3-MST, EC 2.8.1.2), cysteine aminotransferase (CAT, EC2.6.1.3), thiosulfate dithiol sulfur transferase (TST, EC 2.8.1.5). H2S is known for its anti-apoptotic, antioxidant, anti-inflammatory and pro-angiogenic activity, and changes in endogenous H2S production are associated with various diseases. However, information on endogenous H2S production in the heart of diabetic rats is very controversial and limited. Recent studies have shown that H2S participates in vasorelaxation, cardio protection and inhibition of vascular remodeling, and that the violation in the CSE / H2S pathway is involved in the development of some cardiovascular diseases. The purpose of this study was to investigate whether H2S system is involved in the development of diabetic heart in rats.

Methods: We measured the content of H2S, activity of CSE, CAT, TST, the influence of NaHS (exogenous H2S donor) on these parameters in the myocardium of rats. Twenty-one male albino rats (180-250g) were selected for the experiment. Rats were randomly divided into three groups: - healthy control, 4-week STZ- diabetes model, 4-week STZ-diabetes model, subjected to i/p injection of NaHS (14 mmol / kg / day) for 28 days. Hyperglycemia was induced by a single i/p injection of STZ (40 mg/kg). H2S in the myocardium of rats was determined by spectrophotometry (Wilinski (2011). The activity of H2S synthesizing enzymes - CSE, CAT, TST in myocardial homogenates were evaluated in an adapted incubation medium by the growth of a sulfide anion.

Results: Our results suggest that H2S content in the heart of STZ-diabetic rats tended to decrease compared to control (35.4%, $p < 0.05$). However, after administration of NaHS, the H2S content in myocardium of STZ- diabetic rats exceeded that in STZ-diabetes group by 24.8% ($p < 0.05$) and was significantly lower than control by 20.4% ($p < 0.05$). The activity of CSE, the key enzyme involved in H2S production in the cardiovascular system, CAT and TST, was lowered in STZ-diabetic rats (56%, $p < 0.05$; 33%, $p < 0.05$; 35%, $p < 0.05$ respectively), which may have contributed to a decrease in H2S levels. The injection of NaHS for 28 days did not cause significant changes in CSE, CAT, and TST activity.

Conclusions: Our findings suggest that H2S levels in the heart of STZ-diabetic rats have been reduced due to changes in the activity of the major H2S -producing enzymes that may be involved in the pathogenesis of cardiovascular diabetic complications

Speaker Biography

Iryna Palamarchuk, PhD student, professor assistant at Department of Biochemistry and General Chemistry at Vinnytsa National Medical University named after Pirogov, Vinnytsa, Ukraine. She completed her MD from Vinnytsa National Medical University named after Pirogov, Vinnytsa, Ukraine in 2007. From 2007 to 2011, she worked as a general practitioner at a public hospital and ambulance. She has been working as a professor assistant at the Department of Biochemistry and General Chemistry at Vinnytsa National Medical University named after Pirogov since 2012. In 2016, she became a PhD student at the same department. She joined the research team which focuses on the investigations into hydrogen sulfide and sulfur-containing amino acids metabolism in setting of diabetes mellitus and obesity for effective treatment.

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