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Research Article

Effect of Alpha1(A)-Adrenoreceptors Stimulation on Isolated Rat Heart Coronary Circulation in Ontogenesis

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Abstract

α1A-receptor subtype can mediate a positive inotropic effect in stressful and pathological situations. In this regard, the study of the role of this receptor subtype in the regulation of the blood supply to the heart is gaining relevance. The aim of this study was to investigate the effect of α1A-adrenoreceptors stimulation on coronary flow in isolated hearts of rats in ontogenesis. The heart of newborn rats has no sympathetic innervation, 3-week-old animals are characterized by the beginning of the sympathetic cardiac innervation development, 6-week-olds - by its completion and 20-week-old animals have mature innervation of the heart. The isolated hearts were perfused with Krebs-Henseleit solution using a Langendorff chamber (AD Instruments) at 37°C and constant carbogen oxygenation. Stimulation of α1A-AR with A-61603 changed the CF in rats of 6 week-old, as well as in adult animals. The speed of isolated heart CF in 3 and 1 week old rats did not change in response to A-61603 (10^{-9} mol/L).

Keywords: *α1A-Adrenoreceptors; Isolated Heart; Coronary Circulation; Ontogenesis*

Background

In the mammalian heart, alpha1-adrenergic receptors (α1-AR) perform many functions: they participate in the regulation of myocardial contractility, heart chronotropy, coronary blood flow, as well as in various pathological processes [1,5]. Earlier, we showed that non-selective stimulation of α1-AR in adult rats reduces coronary circulation, and in 1-week-old rat pups it enhances it [4]. According to scientists, the α1A-receptor subtype can mediate a positive inotropic effect in stressful and pathological situations [2,3]. In this regard, the study of the role of this receptor subtype in the regulation of the blood supply to the heart is gaining relevance.

Aim of the Study

The aim of this study was to investigate the effect of α1A-adrenoreceptors stimulation on coronary flow in isolated hearts of rats in ontogenesis.

Materials and Methods

The experiments were conducted on 20-, 6-, 3- and 1-week-old outbred rats. These age groups were selected based on the basic stages of formation of the innervation of the cardiovascular system of rats. The heart of newborn rats has no sympathetic innervation, 3-week-old animals are characterized by the beginning of the sympathetic cardiac innervation development, 6-week-olds - by its completion and 20-week-old animals have mature innervation of the heart.

The isolated hearts were perfused with Krebs-Henseleit solution (NaCl 118,0 mm, KCl 4,7 mm, $NaHCO_3$ 25,0 mm, $MgSO_4$ 1,2 mm, $CaCl_2$ 2,5 mm, KH_2PO_4 1,2 mm, glucose 5,5 m.) using a Langendorff chamber (AD Instruments) at 37°C and constant carbogen oxygenation. Retrograde gravity perfusion was performed at a constant hydrostatic pressure of 60 - 65 mm Hg. The experiments we used selective agonist α1A-AR A-61603 (10-9mol/L). The degree of coronary circulation was evaluated using the indicator-coronary flow (CF), which was calculated by measuring the amount of perfusate flowing through the coronary vessels of the isolated heart for 1 minute. Statistical processing of the obtained results was performed using the Student's t-test.

Results

Perfusion of A-61603 10^{-9} mol/L caused an increase CF isolated heart of 20- and 6-week-old rats by 12% ($p < 0.01$) and 10% ($p < 0.05$), respectively. The speed of isolated heart CF in 3 and 1 week old rats did not change in response to A-61603 (10^{-9} mol/L).

Conclusion

Stimulation of α1A-AR with A-61603 changed the CF in rats of 6 week-old, as well as in adult animals. The absence of changes in CF in 1-week and 3-week-old rats on the introduction of A-61603 is probably due to the lack of sympathetic innervation of the heart of animals at this period of postnatal development.

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