Title : ARTERIAL AND VENOUS RESPONSES TO THREE CATECHOLAMINES: DOPAMINE, DOBUTAMINE, AND EPINEPHRINE

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INTRODUCTION. The actions of catecholamines on the venous circulation as well as on arterial vascular beds are important in supporting cardiovascular function.[1] The purpose of this study was to examine the action of three catecholamines: dopamine (DOP), dobutamine (DOB), and epinephrine (EPI), on both arterial and venous vascular beds using cardiopulmonary bypass in dogs. In addition, sympathetic efferent nerve activity (SENA) was recorded simultaneously and its contribution to the response was examined.

METHODS. 18 dogs were used in three groups: DOP, DOB, and EPI. Dogs were anesthetized with pentobarbital, intubated and mechanically ventilated. Arterial blood pressure, central venous pressure, and heart rate were recorded continuously. After median sternotomy, cardiopulmonary bypass was instituted using Sarns roller pump and Shiley reservoir oxygenator. Systemic perfusion was performed through cannulae placed in the femoral arteries and perfusion flow was kept constant. Venous return was separated into three compartments: splanchnic (SPL), renal (REN), and the other vascular beds. SPL and REN outflows were collected through cannulae in the inferior vena cava at the level of the diaphragm and in the abdominal vena cava at the level of renal veins, respectively. The abdominal vena cava was ligated above and below the renal veins. Superior vena cava, right ventricle, left ventricle, and left femoral vein were cannulated to collect the other outflow. Venous outflow was measured using a Biotronix electromagnetic flow meter. Changes in systemic blood volume (SBV) were calculated from the changes in total outflow which is the summation of three outflows. The left ansa subclavian nerve was isolated for simultaneous SENA recording. Drugs of the following doses (in ug/kg) were administered into the reservoir by bolus: DOP 20, 200; DOB 20, 100; EPI 2, 10. In each dog, the measurements were done under three conditions: nerve intact (CON), baroreceptor deafferented (DEN), and after hexamethonium (HEX). Analysis of variance and paired-t test were used for statistical comparison.

RESULTS. EPI increased and, on the contrary, DOB decreased the mean arterial pressure (MAP) dose-dependently under all three conditions. DOP decreased the MAP with low dose under CON and after DEN, but increased the MAP with high dose after HEX. DOP and EPI caused an increase in SPL outflow under HEX, but under CON and after DEN, DOP and high dose EPI caused a decrase in SPL outflow. Figures show the changes in SBV casued by three catecholamines. All three drugs reduced SBV significantly after HEX, although the changes with DOB were much less than those with DOP and EPI. DOP and EPI decreased the SENA under CON and after DEN significantly, but no significant change was observed with DOB. The effects on the renal vascular resistance, which was calculated from the MAP and REN outflow, were as follows: EPI increased, DOP decreased with low dose but increased with high dose after HEX, and DOB showed a tendency to increase but changes were not significant.

DISCUSSION. The results from the experiments after HEX suggest that EPI and DOP have direct actions to decrease the SBV which lead to an increase in venous return to the heart. The increase in outflow from splanchnic vascular bed, that is probably due to venoconstriction, must contribute to those changes. However, under conditions when baroreflexes are intact (CON), the changes in SBV were little. The possible reasons are: 1) high vascular tone compared to HEX condition; and 2) the contribution due to the decrease in SENA. DOB caused a decrease in MAP, which indicates the dilatation of the resistance arteries, although it does not decrease the renal vascular resistance. On the other hand, DOB shows a tendency to decrease the SBV. These effects of DOB on both artery and venous return must contribute to the increase in cardiac output together with its effect on the heart.

REFERENCES.

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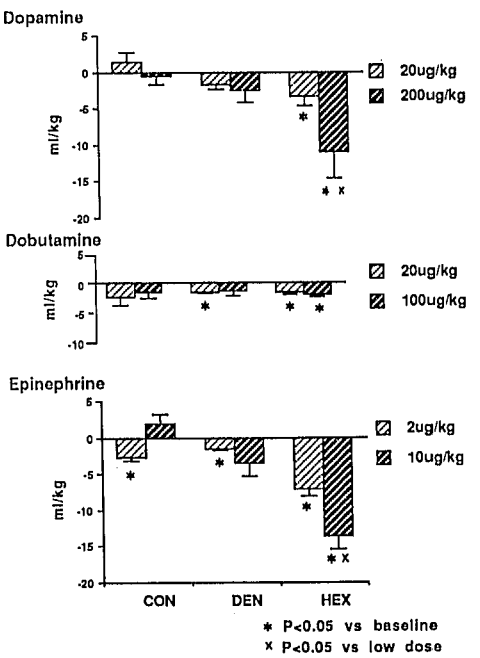

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