The Effects of Phentolamine on Cerebral Hemodynamics During Selective Cerebral Perfusion at Deep Hypothermia in the Neonatal Pig Model

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INTRODUCTION

The mortality rate of neonates undergoing cardiac surgery for repair of congenital heart defects has decreased recently due to surgical technique advancements. However, these patients remain vulnerable to brain injury during surgery due to cerebral ischemia that may lead to manifestations of neurological dysfunction postoperatively. Patients undergoing cardiopulmonary bypass (CPB) and hypothermic circulatory arrest (HCA) followed by selective cerebral perfusion (SCP) are at a greater risk for neurological injury, with an incidence reported to be as high as 25%. Vasodilatation due to CPB can cause decreased blood flow to vital organs of the body. To counteract these effects, vasodilators that block the adrenergic response have been used clinically. Phentolamine has been used as a peripheral vasodilator. It is classified as a α1 and α2 catecholamine receptor blocker that causes vasodilation and hypotension. However, whether phentolamine impairs or improves cerebral circulation remains unknown. The goal of this pilot study was to determine the effect of phentolamine on cerebral flow (CBF), cerebral vascular resistance (CVR), and cerebral oxygen extraction (CMRO).

MATERIALS & METHODS

Experiment protocol:

The animals in the experimental group received a continuous IV infusion of phentolamine at the start of SCP, the other group did not receive any phentolamine during SCP. Eight samples were collected: a baseline, seven samples during SCP at 15 minute intervals, and a post-SCP sample. Cerebral arterial and venous samples collected from the perfusion pump and the external jugular vein, respectively, were obtained simultaneously for calculation of CMRO₂ (arteriovenous oxygen content difference). CBF was measured from the perfusion pump during SCP. The other variables that were measured included arterial oxygen saturation, arterial oxygen pressure, external jugular venous oxygen saturation, arterial pH, external jugular venous oxygen pressure, venous pH, cerebral mean arterial pressure, cerebral mean venous pressure, and hemoglobin. These variables were gathered from monitors and blood gas analysis using the iSTAT machine.

RESULTS

Comparison of Indexed CBF Averages in Control and Experimental Groups

Figure 1: These are the averages of the indexed measurements for CBF for the control and experimental groups over time. Standard error bars are shown for the control and experimental groups.

Comparison of Indexed CVR Averages in Control and Experimental Groups

Figure 2: These are the averages of the indexed calculations for CVR for the control and experimental groups over time. Standard error bars are shown for the control and experimental groups.

Comparison of Indexed CMRO₂ Values during SCP in Control and Experimental Groups

Figure 3: Averages of the indexed calculations for CMRO₂ for the control and experimental groups over time. Standard error bars are shown for the control and experimental groups.

Difference Between Indexed CMRO₂ Averages in Control and Experimental Groups

Figure 4: Averages of the indexed calculations for CMRO₂ for the control and experimental groups, similar to Figure 3, but during SCP only. Standard error bars are shown for the control and experimental groups.

REFERENCES