technique with Fem-Flex II cannula for all aortic cannulations.

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IS HYPOTENSION OR TISSUE OXYGENATION RESPONSIBLE FOR MORBIDITY AND MORTALITY AFTER CARDIOPULMONARY BYPASS?

To the Editor:

I read with great interest the study by Ono et al¹ in a recent issue of the Journal. The authors elegantly showed that the duration and magnitude of blood pressure less than the lower limit of cerebral autoregulation, characterized by a moving Pearson's correlation coefficient between the blood pressure and low-frequency near-infrared spectroscopy signals, was associated with morbidity and mortality after cardiopulmonary bypass.

However, there might be a need to clarify whether it is hypotension per se that is responsible for the adverse outcomes or whether tissue oxygenation is important. The authors did not detail how hypotension was treated during cardiopulmonary bypass, and the methods by which arterial pressure is increased seem important. If the blood pressure is elevated by vasoconstriction, it could affect the blood flow to vital organs. Notwithstanding the small differences in the mechanisms of action to increase the blood pressure, both phenylephrine and norepinephrine seem to affect brain oxygenation in healthy subjects,² in

patients undergoing elective noncardiac surgery experiencing anesthesia-induced hypotension³ and in patients undergoing cardiac surgery and experiencing hypotension during cardiopulmonary bypass.⁴ A restraint in brain oxygenation by these vasopressors could be induced by reflex elevation in vascular resistance triggered by the elevation in blood pressure and supported by a low cardiac output. Changes in flow affect the brain and systemic oxygen balance to a greater extent than do changes in the blood pressure in cardiopulmonary bypass patients.⁵

I acknowledge that whether a reduction in brain oxygenation induced by the administration of phenylephrine or norepinephrine is associated with postoperative morbidity and mortality has not been evaluated. However, preservation of brain oxygenation during surgery is important because of the association between the reduction in frontal lobe oxygenation and jugular venous oxygen saturation and early postoperative neurologic dysfunction in patients undergoing cardiopulmonary bypass for cardiac surgery. In contrast, when the reduction in cerebral oxygenation has been prevented or corrected, the neurologic outcome, including the stroke rate, has been improved.

In conclusion, I agree that careful management of blood pressure during cardiopulmonary bypass is necessary to reduce the risk of postoperative morbidity and mortality. However, it should also be considered that some of the agents used to treat intraoperative hypotension have the potential to affect the blood flow and oxygenation of vital organs. The reduction in oxygenation associated with hypotension could persist after the correction of blood pressure using some vasopressors, such as phenylephrine and norepinephrine.

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Reply to the Editor:

We appreciate the interest in our recently published report¹ by Dr Brassard in his letter to the Editor.² The major theme of his letter brings up the age-old rhetorical question of whether flow or blood pressure is more important for organ perfusion during cardiopulmonary bypass. Physiologically, the body has many mechanisms to preferentially perfuse the brain at the expense of visceral organs, which was adroitly demonstrated in a study by Rhee et al.³ In that study, renal perfusion was compromised by reduced blood flow at blood pressures greater than the lower limit of cerebral autoregulation. Thus, cerebral blood flow was preserved because the blood pressure was within the autoregulation range even when renal perfusion was reduced by 50%. These results further support the notion that during the