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

normal conduct of cardiopulmonary bypass in which the blood flow is kept within a physiologic range, the blood pressure will be the most important determinant of cerebral perfusion.

Dr Brassard² cited studies by himself and others showing that the administration of phenylephrine and norepinephrine reduced the near-infrared spectroscopy–measured regional cerebral oxygen saturation (rScO₂) but that this measurement was not affected by equivalent doses of ephedrine. We caution, however, in interpreting these data as an indication that the cerebral oxygen saturation has been compromised by the use of vasoconstrictors. Clinically available near-infrared spectroscopy monitors use algorithms to subtract light absorption from superficial tissue (eg, scalp, bone, pia) from deeper tissue to provide the rScO₂ measurements.⁴ The importance of extracranial contamination of rScO₂ measurements has recently been highlighted in studies in which scalp ischemia induced by inflation of a circumferential cranial tourniquet affected the rScO₂ readings.⁵ Whether phenylephrine or norepinephrine induces vasoconstriction of the scalp blood vessels, rather than reduces the cerebral oxygenation per se, is an explanation of the lower rScO₂ measurements when these drugs are given has not been excluded. Furthermore, whether this source of error in interpreting the rScO₂ results has clinical importance when near-infrared spectroscopy is used as a trend monitor is unclear. More importantly, the use of rScO₂ as a surrogate of cerebral blood flow for autoregulation monitoring analyzes the correlation of rScO₂ with the mean arterial pressure at the low frequencies associated with autoregulation.^{6–8} These measurements are not dependent on the relative rScO₂ values but, rather, on the relationship between the changes in rScO₂ and blood pressure. Regardless, our ongoing randomized clinical trial of blood pressure management using

autoregulation monitoring versus the standard of care of empiric blood pressure targets during cardiopulmonary bypass (clinicaltrials.gov registration NCT00769691) could shed light on whether “hypotension” versus its treatment with vasoconstrictors affects patient outcomes. (Our study was funded in part by grant R01HL092259 from the National Institutes of Health to Dr Hogue.)

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FREE RIGHT INTERNAL THORACIC ARTERY GRAFT VERSUS RADIAL ARTERY DURING TOTAL ARTERIAL REVASCULARIZATION OFF-PUMP CORONARY ARTERY BYPASS GRAFTING: TRULY SUPERIOR?

To the Editor:

Although in their recent article Navia and colleagues¹ concluded that their study provided evidence for the superiority of the free right internal thoracic artery (RITA) graft compared with the radial artery (RA) during total arterial revascularization off-pump coronary artery bypass grafting, their data do not support this sweeping conclusion. In fact, their study showed no differences in operative mortality, perioperative complication rates, and intermediate Kaplan Meier-survivals between the propensity matched RITA and RA groups. The unmatched comparisons are not relevant because of the very significant heterogeneity between the groups. Their evidence of the RITA superiority is thus based only on the observed significant difference in the combined postoperative reintervention and readmission rates.

Navia and colleagues¹ did not specify the actual rates of reintervention or readmission, nor did they elucidate the events resulting in reintervention or readmission. Late events were also retrospectively gathered from “direct communication with the patient, their family, and attending physician,” a less than ideal means of follow-up. Complications that often result in readmission are not reported. What were the rates of sternal