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Comparison of *pH*-stat and Alpha-stat Cardiopulmonary Bypass on Cerebral Oxygenation and Blood Flow in Relation to Hypothermic Circulatory Arrest in Piglets

To the Editor:—We read with interest the study by Kurth and associates¹ relating to the comparison of *pH*-stat and alpha-stat strategies for cardiopulmonary bypass on cerebral blood flow and oxygenation using near-infrared spectroscopy and laser Doppler flowmetry in piglets. Kurth *et al.*¹ concluded that the use of *pH*-stat acid-base management compared to alpha-stat improved cortical physiologic recovery after deep hypothermic circulatory arrest.

There are significant differences between their experimental design and clinical protocols for pediatric cardiopulmonary bypass. Mean arterial pressures immediately before deep hypothermic circulatory arrest were 74 ± 11 mmHg and 72 ± 8 mmHg in the alpha-stat and *pH*-stat groups, respectively. These pressures are extremely high for 2- to 3-kg piglets at pre-deep hypothermic circulatory arrest. In the clinical setting, mean arterial pressures are typically kept below 40 mmHg.

A bubble oxygenator was used in their study. According to the 1994 pediatric survey, 93.5% of all pediatric centers use membrane oxygenators exclusively in the United States.² Only 6.5% of all centers use membrane and bubble oxygenators. Bubble oxygenators are used only for short, uncomplicated cases, not with deep hypothermic circulatory arrest. It has been clearly documented that the use of membrane oxygenators significantly reduces gaseous and particulate microemboli.^{3,4}

Despite these concerns, it is interesting that *pH*-stat management significantly improved cortical recovery with high mean arterial pressures in their experimental setup.

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In Reply:—Undar *et al.* point out two differences in cardiopulmonary bypass protocols between our laboratory study¹ and current clinical practice. Arterial pressure during deep hypothermic cardiopulmonary bypass was high in our piglets compared with human neonates. There are several physiologic reasons for this. Normal

arterial pressure in newborn pigs is higher than in newborn humans, and the hemodynamic response to deep hypothermic cardiopulmonary bypass in healthy piglets is robust compared with human newborns with cardiac disease. In addition, our cardiopulmonary bypass cooling protocol held flow rate constant, whereas some