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Replacement of Air by Carbon Dioxide

To the Editor:—Cerebral air emboli can produce neuropsychologic deficits after cardiac surgery.^{1,2} O'Brien and colleagues³ demonstrated with ultrasonography that this risk is substantial and occurs frequently in children.

Carbon dioxide, which is some 300 times more soluble than nitrogen, (partition coefficient N_2 0.0147; CO_2 4.0 at 37°C) might substantially reduce the risk of damage with gas microemboli.^{4,5} However, the most effective method for replacing air by carbon dioxide was not described. We found,⁶ in models of a chest cavity, that 5 l/min CO_2 flowing into the field produced the highest carbon dioxide concentration (70–80%). Higher flows did not improve the elimination of air. Two jets larger than 0.5 cm in diameter were optimum; smaller jets were unsatisfactory, causing turbulence and entraining air. The jets should be directed downward into the thoracic cavity aimed at the central region. Although suction rapidly reduces the carbon dioxide concentration, after suction ceased, these returned within 1 min. The method could be confined to the period just before closure of the heart or the great vessels.

In 1968, we recommended that a controlled trial, using these conditions, should be undertaken. However, there were problems in measuring the outcome variables. Since then, methods for detecting neuropsychiatric lesions and cerebral microemboli have been developed. It should be relatively easy to test this simple preventative measure.

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In Reply:—We thank Dr. Rosen for his interesting comments about our report. Our focus was to report the incidence and timing of cerebral microemboli during cardiac surgery in children; however, it is logical to consider interventions that might reduce the number of these (presumed gaseous) emboli. Displacement of air in the operative field by carbon dioxide is certainly such a preventative measure that deserves further study. We would only caution that controlled studies of neuropsychiatric deficits after cardiac surgery in children are difficult because of multiple confounding variables, including nonhomogeneity of cardiac lesions, duration of preexisting cyanosis, use of deep

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hypothermic circulatory arrest, and difficulty in detecting neurologic injury in very young children.

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