Cutaneous Monitoring of Carbon Dioxide Tension during Bronchoscopy in an Infant with Airway Obstruction

To the Editor:—Accurate monitoring of ventilation during diagnostic rigid bronchoscopy for infants with stridor is difficult, and a significant degree of unrecognized hypoventilation can occur. Although continuous evaluation of arterial oxygen saturation is available with pulse oximetry, these devices do not indicate adequacy of ventilation. End-tidal CO₂ monitors are difficult to employ during the change from spontaneous awake ventilation, through assisted ventilation via a mask, to bronchoscopic ventilation. We report the application of cutaneous P_{CO₂} (PtCO₂) monitoring during pediatric bronchoscopy in a patient with a subglottic hemangiomata and compromised ventilation.

REPORT OF A CASE
A 4-month-old infant with stridor and moderate respiratory distress was scheduled for diagnostic rigid bronchoscopy. Thirty minutes prior to anesthetic induction, a cutaneous CO₂ electrode (Biochem MicroSpan™) was placed on the infant’s chest. Monitoring while spontaneously breathing revealed a corrected PtCO₂ of 45 mmHg. Following 2 min of preoxygenation, halothane concentrations were incrementally increased to 3% while the infant maintained spontaneous ventilation. As the depth of anesthesia increased, the infant’s respiration became more labored with the respiratory rate increasing from 30 to >60 shallow breaths/min. Precordial stethoscope confirmed the presence of airflow, and pulse oximeter indicated 100% hemoglobin O₂ saturation. Nevertheless, corrected PtCO₂ steadily climbed from 45 to 65 mmHg. Placement of an oral airway had no effect on relieving airway obstruction. Because synchronizing assisted ventilation was difficult with this degree of tachypnea, a succinylcholine infusion was started and ventilation was easily controlled. Following insertion of the rigid bronchoscope, combined conventional positive pressure and high-frequency jet ventilation was applied through the bronchoscope as corrected PtCO₂ dropped to 35 mmHg over the next 2 min. A subglottic hemangiomata was easily visualized, and following removal of the bronchoscope, the infant was intubated. Despite bilateral breath sounds, PtCO₂ began to rise, followed shortly afterward by a rapid decline in Hgb-O₂ saturation. Esophageal intubation was suspected and the patient was immediately reintubated with a 3.0 mm oral endotracheal tube which was subsequently replaced with a 3.5 mm nasotracheal tube following recovery of PtCO₂ and hemoglobin O₂ saturation. The remainder of the clinical course was uneventful.

DISCUSSION
We report the application of cutaneous P_{CO₂} monitoring for pediatric bronchoscopy. These patients often have airway abnormalities that increase the risk of obstruction and hypoventilation during induction. In addition, use of a rigid Storz® bronchoscope with the Hopkin’s rod lens system results in a markedly diminished lumen for gas flow, severely restricting adequacy of ventilation. Cutaneous P_{CO₂} monitoring provides a means to evaluate indirectly adequacy of ventilation because values correlate with PaCO₂. Volatile inhalational agents used intravenously do not interfere with the Stowe-Severinghaus-type electrode used in the PtCO₂ monitor. Some monitor-related measurement drift may occur in the course of monitoring; a calibration check performed following removal of the skin sensor indicated less than a 2 mmHg drift in our case. Although obtaining a PaCO₂ could be useful in establishing a relationship between P_{CO₂} and PtCO₂, we chose to avoid arterial puncture and institute monitoring prior to surgery, establishing a baseline while the infant was spontaneously breathing. By comparing subsequent changes in PtCO₂ to baseline conditions, we were able to indentify periods of hypoventilation.

STUART WEINBERG, M.D.
Assistant Professor of Anesthesiology and Pediatrics

PAUL WERBIN, M.S.
Student Nurse Anesthetist

Medical College of Virginia
Richmond, Virginia

REFERENCES

(Accepted for publication August 19, 1986)