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

To the Editor:—Accurate monitoring of ventilation during diagnostic 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 CO_2 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_{CO_2} (PTC_{CO_2}) monitoring during pediatric bronchoscopy in a patient with a subglottic hemangioma 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 CO_2 electrode (Biochem MicroSpan™) was placed on the infant's chest. Monitoring while spontaneously breathing revealed a corrected PTC_{CO_2} 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 O_2 saturation. Nevertheless, corrected PTC_{CO_2} 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 PTC_{CO_2} dropped to 35 mmHg over the next 2 min. A subglottic hemangioma was easily visualized, and following removal of the bronchoscope, the infant was intubated. Despite bilateral breath sounds, PTC_{CO_2} began to rise, followed shortly afterward by a rapid decline in Hgb-O_2 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 PTC_{CO_2} and hemoglobin O_2 saturation. The remainder of the clinical course was uneventful.

Discussion

We report the application of cutaneous P_{CO_2} 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_{CO_2} monitoring provides a means to evaluate indirectly adequacy of ventilation because values correlate with Pa_{CO_2}.[1,2] Volatile inhalational agents used intraoperatively do not interfere with the Stowe-Severinghaus-type electrode used in the PTC_{CO_2} monitor.[3] 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 Pa_{CO_2} could be useful in establishing a relationship between Pa_{CO_2} and PTC_{CO_2}, 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 PTC_{CO_2} to baseline conditions, we were able to indentify periods of hypoventilation.

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