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Heated, Humidified High-Flow Nasal Cannula Therapy

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Heated, Humidified High-Flow Nasal Cannula Therapy

To the Editor.—

We read with interest the recent study by Kubicka et al,[1] who assessed oral cavity pressure in patients receiving highly humidified and heated gas (Vapotherm [Vapotherm, Inc, Stevensville, MD]). They found that significant pressure could be generated only with the infant's mouth closed. We had also hypothesized that high-flow gas does not generate significant airway-distending pressure.

In the Neonatal Infant Center at the Children's Hospital of Philadelphia, we chose to study infants already being treated with high-flow nasal cannula with Vapotherm at least 6 hours after initiation of this therapy. We used a 2F flexible, solid-state pressure catheter (Millar Instruments, Inc, Houston, TX) that was passed transnasally to the distance of ~2 cm past the nares at the beginning of the study period. The placement of the catheter was adjusted to provide a pressure signal coincident with placement in the upper nasopharyngeal space. The pressure signal was recorded by a laptop-based data-acquisition system using TestPoint software (Measurement Computing, Norton, MA). Nasal cannulae with an outer diameter of 2 mm were used for delivery of oxygen. The flow setting on which each patient is stabilized, as determined by the clinical care team, served as the baseline for that patient and the initial point of data collection. Flow changes were performed in 0.5 L/minute increments with 2 measurements below baseline and 2 measurements above baseline flow for each patient.

The first infant was born at 39 weeks' gestation and was being treated with Vapotherm at 4 L/minute and a fraction of inspired oxygen (FIO_2) of 30% when studied at 23 days of age (weight: 3.075 kg). Vapotherm flow rates were varied between 3 and 5 L/minute (in 0.5 L/minute increments). The achieved pharyngeal pressures were 3.5, 3.0, 3.0, 3.0, and 2.5 cm H_2O on 3.0, 3.5, 4.0, 4.5, and 5.0 L/minute of flow, respectively. The second infant was born at 35 weeks' gestation and was being treated with Vapotherm at 2 L/minute and an FIO_2 of 30% when studied at 41 days of age (weight: 3.085 kg). Vapotherm flow rates were varied between 1.0 and 3.0 L/minute (in 0.5 L/minute increments). The achieved pharyngeal pressures were all ~2.0 cm H_2O irrespective of flow rate.

Our study was suspended as a result of detection of colonization of 6 infants using the Vapotherm devices by *Ralstonia* species, a Gram-negative bacillus that infrequently infects humans. The infection-control team at our institution identified the Vapotherm device as a risk factor for these patients. Ten other hospitals had also recovered this organism from Vapotherm devices or patients using them. Vapotherm, Inc then developed new infection-control guidelines including that the filter cartridges be used either for a single patient or undergo a high-level disinfection reprocessing protocol. In addition, they suggested that the filters not be used for >60 cumulative days and that sterile water be used in the delivery circuit. These findings and recommendations were reported to and published by the Centers for Disease Control and Prevention,[2] and our institution suspended use of the device pending additional data.

In this very small sample, high-flow nasal cannula oxygen delivered with the Vapotherm 2000i did not result in significant pharyngeal pressure (as an index of airway-opening pressure) in this very small population. We obviously did not achieve the targeted sample size (20 infants), and we could easily be missing a true physiologic effect of the device. However, our data supplement the data of Kubicka et al[1] and other published data[3] that suggest that leak (via mouth, around nasal cannula, or both) may be the major determinant of achieved pressure. These data would suggest that airway pressure be measured whenever generation of distending pressure is the clinical intent.

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In Reply.—

We welcome the interest shown by Weiner et al in our article on the use of high-flow nasal cannulas in the neonatal population. However, we would like to address a few important issues. The authors report the pharyngeal pressures achieved by using Vapotherm with 2-mm outer-diameter prongs in only 2 large infants. They describe passing a 2F catheter transnasally to measure pharyngeal pressure, which possibly could have altered the size of the nasal leak. We also emphasized that for infants who weighed >1500 g, we found no relationship between the flow rate and maximal oral cavity pressure, which we attributed to the presence of a larger nasal leak. Oral cavity pressure generated by high-flow nasal cannula ultimately depends on whether the mouth is closed, the flow rate, and the size of the nasal leak. Clinically relevant levels of continuous positive airway pressure could be achieved only in infants <1500 g with higher flow rates and their mouths fully closed. The most important issues addressed by our study were safety and monitoring. Clinicians who use high-flow nasal cannula therapy should be aware of the possibility of generating high pressures in the smallest infants when using higher flow rates with the infants' mouths fully closed and when the nasal leak is minimized or eliminated by using larger nasal prongs.

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Analgesic Properties of Oral Sucrose During Routine Immunizations

To the Editor.—

I read with great interest the article by Hatfield et al entitled "Analgesic Properties of Oral Sucrose During Routine Immunizations at 2 and 4 Months of Age."[1] The authors concluded that administration of 2 mL of a 24% oral sucrose solution 2 minutes before routine immunizations was effective in decreasing maximum immunization pain and shortened the time before returning to a near-normal state in infants at 2 and 4 months of age.

Sucrose water (12%–50%; typically 1 packet of sugar in 10 mL of water) or other sweet solutions, when administered just before the procedure, have been shown to decrease the pain associated with procedures in neonates.[2] It was thought that sucrose is effective in the neonatal period and loses its efficacy by 4 to 6 months of age.[3] However, Allen et al[4] have suggested 12% sucrose to be no more effective than sterile water but more effective than no intervention in reducing crying times for 2-week-old, 9-month-old, 15-month-old, and 18-month-old children receiving a single injection.

In our busy clinic we administer multiple immunizations serially without significant time in between vaccinations. I agree with Hatfield et al when they reported that sucrose is inexpensive, short acting, nonsedating, easily administered, and noninvasive and does not require additional training. They reported that use of a weight-based volume dose calculation of 0.6 mL/kg of a 24 g/1000 mL (24%) sucrose solution significantly reduced immunization pain. In recent research we evaluated the analgesic effects of a standard dose of 2 mL of 12% sucrose solution and lidocaine-prilocaine cream during vaccination of infants aged between 6 and 48 months and compared them with a no-intervention group. We observed crying time and pain scores to be significantly higher for children in the no-intervention group than those in the sucrose and lidocaine-prilocaine group. We also found that sucrose solution was as effective as lidocaine cream for children in this age group. In addition, parental reassurance, needle length, and injection technique were associated with high pain scores during vaccination in this age group. We expanded on previous findings by demonstrating that sucrose solution at a lower concentration might reduce infant distress and is safe and clinically useful beyond 6 months of age.

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