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BRIEF REPORT

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Aerosol generation by respiratory support of neonates may be low

The COVID-19 pandemic has had a major impact on health care and including how healthcare staff deliver and admit newborn infants to neonatal intensive care units and care for them during interhospital transfers. Hospitals have established quarantine zones and provided personal protection equipment and viral filters for use during invasive and noninvasive ventilation. The virus that causes COVID-19 transmits via droplets and can remain viable in aerosols for three hours.[1] In addition to normal intubation and intubating through a tracheostomy and open suction procedures, noninvasive respiratory support (noninvasive ventilation, continuous positive airway pressure, nasal high-flow therapy) has been associated with a higher risk of transmitting respiratory pathogens to healthcare workers, unlike invasive mechanical ventilation using cuffed endotracheal tubes. That is why they are considered aerosol-generating procedures.[2–4]

No studies have measured the concentration of aerosol particles dispersed when infants receive respiratory support.

This study used a manufacturer-calibrated Optical Particle Sizer TSI 3330 (TSI Inc) to measure average aerosol particle mass concentration and size distribution near infants. The study was carried out in several patient rooms in a neonatal intensive care unit.

The instrument measures particles ranging from 0.3 to 10 μm in size, as they pass through a sensing volume illuminated by a laser. The particle sampling used 90-cm carbonised conductive tubing (TSI Inc), which was attached to the inlet nozzle of the OPS. The sampling rate was adjusted to 10 s, and each measurement lasted 140 s. The instrument was successfully self-checked using a zero filter just before measurements.

The air exchange rates in the patients' rooms were 6–8 per hour. Measurements were conducted on seven infants with different types of respiratory support. These were uncuffed endotracheal tubes connected to a ventilator or heat and moisture exchange filter, continuous positive airways pressure via nasal prongs using a Benveniste valve (Dameca A/S) and nasal high-flow therapy (OptiFlow, Fisher&Paykel). The infants were awake or asleep, and none were heavily sedated or receiving muscle relaxants. Measurements were performed 10, 50 and 100 cm from the infant's mouth and nose and close to the exhaust valve of a ventilator without a viral filter and during one open endotracheal suction procedure. The infants did not receive any interventions during measurements.

None of the infants had suspected respiratory viruses or COVID-19. They were nursed in open cots, with parents close by, and two received skin-to-skin contact.

No ethic committee approval was required because we did not collect clinical samples or use patient data. However, the parents consented to the measurements near their children.

All the average aerosol particle mass concentrations were very low and varied between the patient rooms, especially in the larger particle size bins (Table 1). The mass concentrations of smaller particles during noninvasive and invasive respiratory support were comparable. The mass concentrations in the exhaust air of the ventilator without viral filter were slightly lower than near the patients' face. The average particle mass concentrations were similarly low in the staff meeting room used as a reference value (data available on request).

These results indicate that providing neonates with respiratory support was associated with minimal aerosol generation.

This small explorative study had its limitations. Each measurement only lasted 140 s. Although particle losses in the conductive sampling tube were anticipated to be negligible for smaller particles, gravitational losses may have occurred in the largest particles. Parents and healthcare workers were not excluded from the patient rooms during measurements, and this could have increased the measured particle concentrations. None of the infants coughed or sneezed during the measurements, but one cried during open suction. Intubation, extubation and noninvasive ventilation are high-risk aerosol-generating procedures[4] and should be included in future measurements. None of the infants had lung infections. The results may therefore not be directly applicable to patients with COVID-19.

The risk of aerosol transmission from newborn infants with COVID-19 to healthcare staff during respiratory support may be low. However, we need studies on viral dispersion with different sized droplets and various types of neonatal respiratory support to inform neonatal care during outbreaks of airborne infections.

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TABLE 1 Average aerosol particle mass concentrations (μg/m^3) near seven infants with respiratory support

Patient no/respiratory support	Position/procedure	Particle size range in μm					
		0.3–0.58	0.58–1.12	1.12–2.16	2.16–4.16	4.16–10	Total
1. Nasal CPAP 10 L/min(skin-to-skin)	10 cm	0.13	0.03	0.07	0.25	1.39	1.9
2. ETT connected to ventilator (leak 0%–10%/TV 5.6 ml/kg)	VEA	0.05	0.08	0.31	1.12	3.67	5.23
	10 cm	0.06	0.13	0.52	2.04	8.91	11.67
	50 cm	0.04	0.10	0.44	1.64	9.43	11.65
3. nHFT 8 L/min	10 cm	0.07	0.16	0.46	1.02	3.01	4.71
	50 cm	0.08	0.18	0.59	1.40	5.18	7.43
4.ETT with heat and moisture exchange filter	10 cm	0.04	0.10	0.36	1.01	4.99	6.50
	50 cm	0.03	0.07	0.22	0.53	1.73	2.57
	10 cm + OS	0.02	0.06	0.25	0.77	4.89	5.99
5. ETT connected to ventilator (leak 0%–10%/TV 5.0 ml/kg)	VEA	0.02	0.04	0.16	0.31	1.30	1.85
	10 cm	0.02	0.05	0.20	0.56	2.55	3.38
	50 cm	0.02	0.04	0.17	0.47	2.66	3.37
6. ETT connected to ventilator (leak 0%–10%/TV 6 ml/kg)	VEA	0.02	0.04	0.17	0.40	2.27	2.91
	10 cm	0.04	0.08	0.29	0.58	3.13	4.11
	50 cm	0.03	0.07	0.21	0.53	2.63	3.47
7. nHFT 4 L/min(skin-to-skin)	10 cm	0.01	0.03	0.09	0.40	2.50	3.03
	50 cm	0.02	0.03	0.13	0.48	2.45	3.10
Bubble CPAP chamber 10 L/min (positive reference)	5 cm from chamber	0.85	1.85	13.58	35.51	60.84	112.6
Staff room in neonatal department (reference)	None	1.07	0.21	0.16	0.55	2.73	4.72

Abbreviations: CPAP, continuous positive airway pressure; ETT, endotracheal tube; nHFT, nasal high-flow therapy; OS, open suction; TV, tidal volume; VEA, ventilator exhaust air.

CONFLICT OF INTEREST

None.

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