

# Urgent need for neonate HME filters!

**Keywords:** Neonate, ETCO<sub>2</sub>, Anaesthesia, HME

Volume 14 Issue 2 - 2022

## Letter to editor

Heat and Moisture Exchanger (HME) breathing system filters are attached between the tracheal adaptor and the Y piece for warming and humidification of inspired gasses which is especially beneficial in infants.<sup>1</sup> However, we encountered significant increase in end tidal carbon dioxide (ETCO<sub>2</sub>) in one such patient which resulted in impending cardiac arrest.

A 28-day-old, full-term female neonate of 3.8 kgs, with normal biochemical investigations and normal systemic and airway examination, was scheduled for emergency laparotomy. In the operation room (OR), standard monitors were attached. After pre-oxygenation, anesthesia was induced with fentanyl, thiopentone and atracurium. Trachea was intubated with cuffed endotracheal tube 4.5 mm with the help of videolaryngoscope and fixed at 11 cms after confirming equal bilateral air entry. Pressure controlled ventilation with 16cmH<sub>2</sub>O, respiratory rate 30/min and positive end expiratory pressure 3 cm H<sub>2</sub>O was started to maintain tidal volume of 5-8ml/kg and ETCO<sub>2</sub> of 35mm Hg with oxygen air mixture (60:40) and isoflurane. Within five minutes, ETCO<sub>2</sub> increased to 48 mm Hg for which various ventilatory parameters were attempted including increase in minute ventilation, however, in the next two minutes ETCO<sub>2</sub> further increased to 80 mm Hg. Surgery was discontinued. Oxygen saturation was at 94%. Arterial blood gas showed pH 7.24, PaO<sub>2</sub> 278 mmHg, PCO<sub>2</sub> 110 mm Hg, HCO<sub>3</sub> 19.3 mEq/L, Na/K 138/3.9 mEq/L and lactate 3.9 mmol/l. Endotracheal suctioning yielded no secretions. Endotracheal tube migration, kinking or leak of breathing circuit and soda lime exhaustion were excluded. No added sounds on auscultation and discrepancy in inspired and expired tidal volumes were seen. Chest X ray to further explore the cause was not possible intraoperatively. Removal of HME filter (COVIDIEN™ Infant – Pediatric, V<sub>T</sub> 25ml to 75ml), attached to the Y piece of the breathing circuit, was then considered. Following this, ETCO<sub>2</sub> gradually decreased to 40 mmHg over next 3 minutes. Surgery was allowed to commence and was uneventful including repeat normal ABG. Child was extubated after four hours in the pediatric intensive care unit and was discharged four days later with uneventful hospital stay.

The physiological anatomical dead space of pediatric patients is 2.2 ml/kg (about 1/3 of their tidal volume) and is larger than adults.<sup>2</sup> When mechanical ventilation is conducted in them, dead space further increases with breathing circuit, endotracheal tube, tube adaptor, Y piece and humidification-filter devices such as HME filters.

Only one size of pediatric HME of volume 20-25 ml is available worldwide. Morbidity in infants due to HME filters like ineffective ventilation, acidosis, increased temperature and rebreathing have been reported.<sup>3,4</sup> Studies found pediatric HME filters to significantly increase PaCO<sub>2</sub> which decreased on its removal and recommendations for smaller dead space pediatric HME devices in small pediatric patients especially less than 4 kgs was suggested.<sup>5,6</sup> However, no further steps towards this has been carried out.

In the present neonate, significantly increased ETCO<sub>2</sub> could not be reduced with hyperventilation and resulted in hypoxemia and acidemia which if left untreated can lead to fatal complications like arrhythmias, cardiac arrest etc. The HME filter had to be removed for normalcy which exposed the child to hypothermia and infections.

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**Received:** October 18, 2021 | **Published:** April 22, 2022

With the present report we further stress the urgent need of smaller volume HME filters for small weight neonates and prevent adverse sequelae.

**Novel observation:** HME filters in a neonate can cause significant morbidity.

**Criteria for inclusion:** DM involved in first draft writing and conduct of case, PJ involved in conduct of case and final draft writing and submission, PA conduct of case, GK conduct of case.

Manuscript has been read and approved by all the authors, that the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work, if that information is not provided in another form.

## Acknowledgments

None.

## Conflicts of interest

None.

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