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Published in:
American Journal of Respiratory and Critical Care Medicine

DOI:
10.1164/rccm.201809-1781IM

Reverse Triggering: A Novel Type of Patient–Ventilator Asynchrony in Mechanically Ventilated Children

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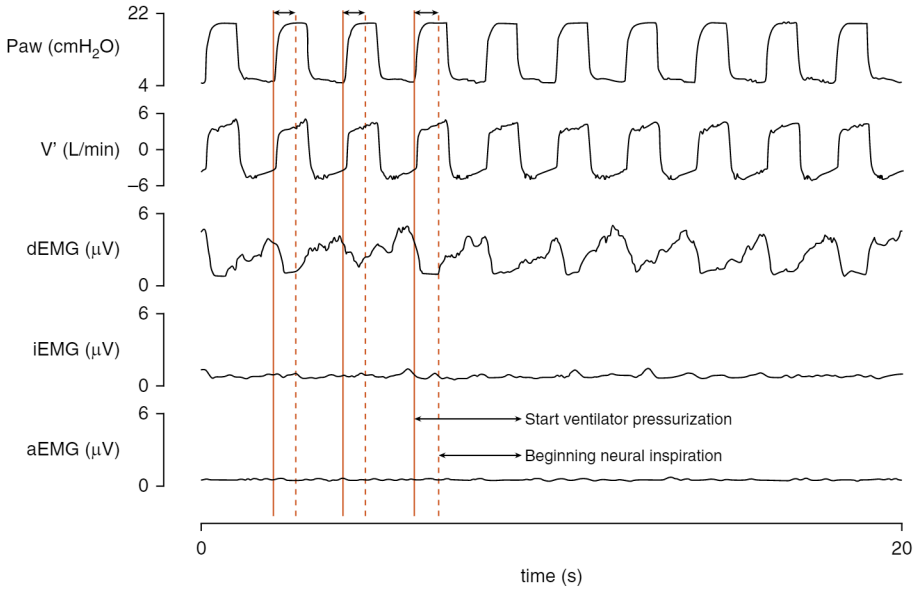

Figure 1. Example of reverse triggering in a mechanically ventilated infant. Patient is ventilated in a time-cycled pressure-limited mode with a peak inspiratory pressure of 20 cm H_2O, positive end-expiratory pressure of 5 cm H_2O, and mandatory rate of 30 breaths/min. Pressure–time and flow–time scalars and electrical activity of the diaphragm (dEMG), intercostal muscles (iEMG), and abdominal muscles (aEMG) are depicted. No ventilator cycle is triggered by the patient. Red lines depict the increase in diaphragmatic activity (dEMG) after ventilator pressurization. Reverse triggering is seen throughout the entire recording, with a ratio of 1:1. There was no activity of the intercostal muscles (iEMG), so the diaphragmatic activity was not caused by ineffective triggering. Also, no abdominal muscle activity (aEMG) was seen; hence, the increased diaphragmatic activity was not a result of active expiration. Paw = airway pressure; V′ = flow.

Reversed triggering as novel type of asynchrony has previously been identified in mechanically ventilated adults (1–3). We are the first to report this type of patient–ventilator asynchrony occurring in children. An 11-month-old infant was admitted to our pediatric intensive care unit after reintubation because of post-procedural subglottic edema-induced respiratory failure. The patient was mechanically ventilated in a time-cycled, pressure-limited mode with the flow trigger set at 1.0 L/min. Sedation was managed with propofol targeting a COMFORT behavior scale of 10 (4). As part of an ongoing clinical study, pressure–time and flow–time scalars and the electrical activity of the diaphragm, intercostal muscles, and abdominal muscles were recorded for 30 minutes with paired surface electrodes (Figure 1). Capillary blood-gas analysis showed a normal pH. During the study period, no patient-triggered ventilator breaths were observed. However, the electrical activity of the diaphragm showed activity of the diaphragm between two machine breaths, indicative of reverse triggering. The neural respiratory time coefficient of variation was 14.3% (±0.29%) (2). Reverse triggering was seen throughout the entire recording in

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Am J Respir Crit Care Med Vol 200, Iss 2, pp e4–e5, Jul 15, 2019

Originally Published in Press as DOI: 10.1164/rccm.201809-1781IM on February 20, 2019
Internet address: www.atsjournals.org

a 1:1 ratio. To date, this type of asynchrony has only been described in deeply sedated or brain-dead adults (1–3). Further studies are needed to understand the mechanism, prevalence, and clinical effect of reverse triggering in mechanically ventilated children. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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