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Reply to Fontana et al.

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We would like to thank Dr. Fontana et al. [1] for their letter addressing our recent publication on the performance of adult ICU ventilators providing neonatal ventilation [2]. They raise two important issues regarding our data that we will address here: (1) trigger pressure and trigger delay, and (2) the variability of our data.

In order to address the issue of trigger delay and trigger pressure, it is important to first understand the difference between our model lung, the IngMar ASL 5000 and the Michigan Instruments 5601i-Adult/Infant PNEUVIEW. As stated by Dr. Fontana et al. [1], they measured changes in airway pressure and flow at the “wye” piece of the ventilator circuit proximal to the lung model’s compliance and resistance. As has been done with other Michigan Instruments lung model studies, the onset of inspiration for measurement purposes occurred when either pressure deflected below baseline or a change in flow was measured at the circuit “wye” [3, 4]. However, before this change occurred at the wye, the lung model needed to be decompressed and the resistance and compliance overcome for pressure and flow to

change at the wye. Thus, time was spent and pressure was dissipated before a change was ever measurable at the circuit wye. In the IngMar, the pressure to trigger and the time to trigger were measured inside the lung model itself. As a result, the compliance and resistance of the lung model had to be overcome before pressure and flow could change at the circuit wye. Hence the longer time to trigger and greater trigger pressure than that observed by Fontana et al. in the same ventilator [1]. We believe our measurements [2] reflect more closely the pressure and time to trigger experienced by a neonate triggering the ventilator evaluated. As noted in the supplement to our article, the P0.1 of our model was even higher than that set by Fontana et al. [1] (−4 and −7 cm H₂O vs −2 cm H₂O). Thus, one would expect the time to trigger to be shorter in our study and the pressure to trigger to be greater. The pressure to trigger was greater but the time to trigger was longer because of measurement inside the lung model versus at the circuit wye.

The variability depicted in Figs. 2–5 of our paper results from a number of factors [2]. First of all, 24 separate conditions were evaluated for each ventilator studied. These included three different settings of compliance/resistance, two different muscle efforts, two different ventilator settings, and each of the above with and without a system leak. We agree with Dr. Fontana that, during a single evaluation, the variability among a series of breathes on a lung model are extremely small, but if you collapse findings under a number of different circumstances variability increases greatly, which is what we present. For example, Fig. 2 depicts the effects of the three compliance/resistance settings, but this represents the average data from two different muscle efforts and two ventilator settings all with

and without a system leak! Thus the high variability noted in this figure. Finally, the level of variability among ventilators was considerable; some varied greatly over the 24 test conditions while others did not!

References

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