Editorial

Duration of postoperative mechanical ventilation in neonates

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Mechanical ventilation (MV) in neonates following surgery is a rather unusual topic. In most of the studies on MV, surgery is an exclusion criterion. Hence, the study by Wang *et al.* (1) on MV in neonates following gastrointestinal surgery from the Toronto Hospital for Sick Children is a welcomed analysis of an adequate sample of neonates heaving needed gastrointestinal surgery.

The authors retrospectively reported on intestinal pathologies necessitating surgery during a 2-year period. Pathologies included necrotizing enterocolitis/spontaneous intestinal perforation (NEC/SIP) in 21%, intestinal atresia in 16%, esophageal atresia/tracheoesophageal fistula in 14%, anorectal malformation in 13%, malrotation/volvulus in 11%, gastroschisis in 9% and omphalocele in 4% of the cohort. In detail, the median duration of MV was 9 days in 54 cases with NEC/SIP; 2 days in 41 cases with intestinal atresia; 3 days in 35 cases with esophageal atresia/tracheo-esophageal fistula; 1 day in 34 cases with anorectal malformation; 2 days in 27 cases with volvulus/malrotation; and 3 days in 22 cases with gastroschisis. Sixty-five infants, a quarter of the study population, exhibited prolonged MV defined as more than 7 days. The duration of MV strongly correlated with the diagnosis NEC/SIP and prematurity, but not all infants who needed longer respiratory support were premature born. The overall results revealed that neonates with prolonged MV had a lower gestational age, lower birth weight and lower weight at the time of surgery, and a higher percentage of stoma creation procedure, longer post-operative opioid administration, and higher rates of moderate to severe bronchopulmonary dysplasia (52% *vs.* 2.7%) and mortality (13.8% *vs.* 5.9%). Of the 122 patients handled by one-stage resection with primary anastomosis, 22% received non-invasive ventilation (NIV) and 74% still were on NIV after 7 days post-surgery. Interestingly, anastomotic leak was detected in only three (2.5%) patients and did not correlate with NIV. The authors concluded that lower gestational age and longer opioid administration were risk factors for prolonged MV in neonates following intestinal surgery. Forty-one percent of surviving neonates with NEC/SIP survivors had endotracheal intubation on MV support post-surgery for more than 14 days. Additionally, those with NEC/SIP and having stoma creation at surgery had again longer duration of MV and differences were impressive being 23 compared to 5 days; rates of moderate to severe BPD were similar.

Although high flow nasal canula (HFNC) or continuous positive airway pressure (CPAP), the usual modes of NIV, may reduce the work of breathing, there are no outcome data showing superiority of HFNC or CPAP over any other intervention (2). In adults NIV as a weaning strategy reduced rates of death and pneumonia without increasing the risk of weaning failure or reintubation (3). Weaning protocols have been demonstrated to successfully reduce the duration of MV in critically ill adults resulting in reduced weaning duration and reduced length of stay at the intensive care unit (4).

Much of the common practice in pediatric MV is based on personal experiences. NIV can be used before

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considering intubation in most cases of mild-to-moderate respiratory distress. NIV should not delay endotracheal intubation, but no specific limits can be provided in any disease condition. Which modes of ventilator or respiratory support might be recommended was the question for an expert panel discussing different modes of MV for children. The results were inconclusive and the experts could not give an answer (2). The question remains: Is ventilating neonates and infants art or science? Maybe it is both, and certainly, it depends on years of experience in ventilating neonates.

In preterm infants, nasal intermittent positive pressure ventilation (NIPPV) reduces rates of extubation failure and the need for reintubation within 48 hours to one week more effectively than nasal CPAP (5,6). NIPPV versus NIPPV reduced rates of extubation failure and need for reintubation within 48 hours to one week more effective than nasal CPAP, but NIPPV had no effect on development of chronic lung disease or mortality (5). Synchronization in delivering NIPPV and the devices used might be important too. Additionally, NIPPV was not associated with increased rates of gastrointestinal side effects.

One major factor predicting duration of ventilator support is to detect the readiness of the child for extubation. The authors (1) herein do not describe whether there existed a protocol for the weaning phase or criteria for extubation, but performed a spontaneous breathing trial (SBT). The SBT is a possibility to check the extubation readiness (7). Pulse oximeter measured oxygen saturation is monitored for 30 to 120 seconds as is the work of breathing and signs of distress or discomfort, and if the child remains to be stable successful extubation has to be expected. Other variants of testing extubation readiness include the minimal pressure support trial and the CPAP trial with a PEEP of 4–5 cmH_2O (7). In a study on preterm infants, the role of the SBT was tested and showed a sensitivity of 92% in predicting successful extubation (8). More recent studies do not confirm its role in assessing extubation readiness in this population (9,10). There was a ten percent extubation failure rate in preterm infants receiving prolonged MV by using a 3 minutes SBT (9). The authors noted a significant decrease in exhaled tidal volume, a significant increase in breathing frequency, and a significant increase in work of breathing at the end of the SBT. In another study successful extubated neonates (71%) had significantly fewer clinical events (51% *vs.* 72%), shorter cumulative bradycardia duration, shorter cumulative desaturation duration, and less increase in oxygen (0% *vs.* 5%) compared with neonates who failed extubation (10). Thus, extremely preterm neonates commonly show signs of clinical instability during endotracheal CPAP; and the authors concluded that the accuracy of the SBT is low when multiple clinical events in their combinations are necessary to define the SBT. Hence, SBTs may provide only limited value in the assessment of extubation readiness.

There exist a lot of weaning methods, but it is not known which method is superior to all others. Randolph *et al.* (11) investigated whether weaning protocols are superior to standard care (no defined protocol) for infants and children with acute illnesses requiring mechanical ventilator support and whether a volume support weaning protocol using continuous automated adjustment of pressure support by the ventilator was superior to manual adjustment of pressure support by clinicians. Interestingly, extubation failure rates and weaning success did not differ between groups and increased sedative use during the first 24 hours of weaning predicted extubation failure and weaning success as it was the case in the study by Wang *et al.* (1). Time of weaning was overall short with two days or less. Moreover, weaning protocols were not able to shorten this time.

There is not much more evidence regarding weaning children from the respirator. Clinical judgment is still the predominant way to predict weaning and extubation success. Extubation failure rates range from 2% to 20% and there is little or no relationship to the duration of MV (12). Upper airway obstruction is the single most common cause of extubation failure. A reliable method of assessing readiness for weaning and predicting extubation success is not evident from the pediatric literature (12).

Wang *et al.* (1) give an interesting insight into the problems of mechanically ventilated neonates following gastrointestinal surgery with those having had NEC/SIP surgery yet remaining the most critical one.

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