Fifteen years of mechanical ventilation – what have we learned?

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The 15th anniversary of the journal is something we should be very proud of. The quality of the journal has improved tremendously over the years and many distinguished authors have contributed. The last 15 years has also seen important changes in the way we ventilate and wean critically ill patients. The journal has been a constant witness and it seems an excellent moment to summarize.

In 1996 experimental evidence had accumulated that mechanical ventilation with large tidal volumes was actually harmful for the lungs [1,2]. Hickling already published his case series in which pressure limited ventilation with low tidal volumes and so-called "permissive hypercapnia" resulted in a significantly better outcome than expected [3,4]. However, most intensivists were understandably reluctant to apply this new concept and the first Randomized Controlled Trial by Amato in 1998 did not change this mainly due to the small number of included patients and the high mortality in the control group [5]. Three relatively small trials were unable to confirm the benefit of smaller tidal volumes [6-8] but in 2000 the ARDSnetwork study finally confirmed the results of Hickling [9]. As always, this was not the end of the story mainly because the optimal level of PEEP was still unknown. On the one hand were those who strictly followed the rules of the ARDS network with relatively low PEEP levels and on the other hand were those who defended the open lung concept with much higher PEEP levels. Three subsequent trials comparing low with high PEEP levels showed that higher PEEP levels reduced the need for rescue therapies and reduced mortality in the most severe patient group [10-13]. In patients with less severe lung injury, lower PEEP levels were more beneficial. Recent years have seen two other important developments. First, in order to prevent ventilator-induced lung injury in individual patients, the transpulmonary pressure was introduced in clinical practice [14] and the related issues of stress and strain were further elaborated [15]. Real-time monitoring of recruitment and derecruitment is now possible with the introduction of electrical impedance tomography (EIT) [16]. Second, we have seen a revival of extracorporeal techniques for oxygenation and removal of carbon dioxide [17]. Some distinguished scientists even predict the end of mechanical ventilation as the apparatuses for these extracorporeal techniques become more versatile. Personally, I don't think this is the right direction. Many patients are successfully weaned from the ventilator and lead a normal life although ventilator settings were apparently dangerous. It is still very difficult to prove if ventilator-induced lung injury contributed to the final outcome in an individual patient. Trading a relatively safe and proven way of gas exchange for another complex and expensive technique seems illogical to me. A better understanding of the contribution of ventilator-induced lung injury in daily practice would be very helpful.

In the field of weaning, changes have been less dramatic. Recent evidence shows that approximately 6% of ventilated patients experience difficult weaning with serious consequences regarding morbidity and mortality [18]. In 1996 the results of two large RCT's comparing different forms of weaning were already known [19,20]. Although the results were not conclusive, synchronised intermittent mandatory ventilation (SIMV) had the worst outcome in both trials and rapidly lost its popularity. Both T-tube weaning and pressure support ventilation (PSV) became the established techniques. Little has changed over the subsequent years. However, three other important developments, often in combination, have led to a substantial decrease in the duration of weaning. First, several studies found an association between the use of sedatives and the duration of mechanical ventilation [21]. The introduction of sedation scales and drug holidays was the appropriate answer and appeared to be very effective [22]. Based on the idea of "less is more", withholding sedatives completely reduced the duration of ventilation in a select group of patients [23]. The second important step was the introduction of a daily screening test followed by a spontaneous breathing trial (SBT) if appropriate [24]. This increased the awareness of the medical team that patients were probably ready to be liberated from the ventilator. Combining a daily drug holiday with a SBT reduced the duration of ventilator weaning even further [25]. Finally, early mobilization also reduced the time spent on the ventilator [26].

We have seen one other major development that may change the way we ventilate patients. Spontaneous breathing has many benefits but unfortunately pressure support ventilation (PSV) is often badly adapted to the patient. Already in 1999 Sinderby described the concept of neurally adjusted ventilator assist (NAVA), a technique that couples the output of the ventilator to the electrical activity of the diaphragm thereby bypassing flow and pressure signalling [27]. It took many years for NAVA to reach the clinical arena, but now it is finally there. Several studies have shown that patient-ventilator synchrony improves, but outcome studies are not available yet [28,29]. However, if properly introduced, NAVA has the potential to become the new standard mode for spontaneous breathing.
Fifteen years of research in mechanical ventilation has left us with a reliable and relatively safe technique. Browsing the various issues the journal has been a constant witness indeed. I think our journal has a bright future ahead. As the scientific output of the Dutch intensive care society is rapidly growing, our journal deserves our attention. Although the journal receives a substantial number of case records and invited reviews, I am convinced that if only a small part of our original research is dedicated to the journal, we will succeed in obtaining PubMed notation. Let us than take up the challenge and make our 15th anniversary a memorable starting point.

References