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Editorial

Artificial Intelligence in Mechanical Ventilation

Atabak Najafi*

Anesthesia, Critical Care, and Pain Management Research Center, Tehran University of Medical Sciences, Tehran, Iran.

The use of Artificial Intelligence is new concept in field of mechanical ventilation. In these few last years about 90 Articles has been published in field of AI use in mechanical ventilation [1] and to my knowledge there is only one clinical trial comparing AI controlled weaning from mechanical ventilation with conventional method.

Although Hsu et al found AI very useful in weaning patients from ventilator [2] but clinical data about usefulness of AI in prolonged ventilator support or therapy is lacking.

For the first time Hamilton introduced Adaptive support ventilation (ASV) as a closed loop mode of ventilation in 1998. ASV controls Tidal volume and respiratory rate to reach a target for lung protection by using Otis equation. Then in 2013 Jean-Michel- Arnal et al showed safety of full closed loop ventilation Intellivent. ASV in a clinical trial [3].

Intellivent ASV besides tidal volume & respiratory rate, controls Peep and FIO2 by using feedback from ETCO2 and SPO2.

Drager introduced smart care PS a closed Loop system as automated weaning protocol in 2003. In 2006 Lellouche et al showed efficacy of smart care in weaning patients from ventilator [4]. Although these closed loop ventilatory modes are safe and effective in ventilating and weaning patients, in some extreme clinical conditions such as sudden increase in airways resistance or decrease in compliance operator needs to change the ventilator mode and setting according to patient's new condition.

With development of AI its use in field of mechanical ventilation became more pronounced and it led to introduction of Nexovent decision flow which is an interface between operator & ventilator that can recognize ventilation parameters and choose best adjustment for different clinical scenarios so it suggests best adjustment for ventilator and can prevent a ventilator induced lung injury [5]. But clinical data comparing Nexovent to conventional operator setting is not available.

Ventilator by itself is a dangerous device that can cause lung injury so we need to have close supervision on patient's condition and setting of ventilator in the way that do not harm the patient., provide adequate gas exchange, protect the lung, promote patient comfort and liberate the patient from ventilator as soon as possible.

AI can be used for controlling mechanical ventilator in two ways:

1.Open loop control is a form of decision support and final setting is made by operator and AI suggests some modes to the operator.

2.Closed loop control is a form of control that AI adjusts the ventilator [6].

In total computer control ventilator adjustment, AI uses information from sensors of pressure, volume, Flow, respiratory rate, heart rate, PECO2, Pao2, FIO2, SPO2 and PO.1 for adjusting the ventilator parameters.

Despite acceptable ventilation in normal patients computer based control loses its accuracy in the event of bronchospasm, underlying disease, change in strength and endurance of respiratory muscles, disturbance of neural respiratory control, changes in metabolic state cardiovascular abnormality psychological derangement and drug reaction.

To overcome aforementioned problems Automatic adjustment systems using AI tool, control the ventilator by using mathematical models of physiologic systems, Rule based expert systems, Fuzzy logic and artificial neural networks. But still in the complex cases like massive pulmonary air leak, severe ARDS, severe asthma AI may not be able to control the ventilator better than an expert operator.

It seems at present time AI is not ready to control ventilator in extreme clinical conditions and it needs more development.

In the future AI may be used to control ventilators but for being safe and reliable there should be registry database of human experts and network ventilators to keep prior experiences and feed neural network by using data from registry and inputs from neural network.

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*Corresponding author.
E-mail address: atabaknajafi234@gmail.com

Data from AI controlled ventilators and patients outcome after cessation of mechanical ventilation, can be used as feedback for neural network so there would be huge amount of data and will make AI ventilatory control safer.

We need more clinical trials comparing AI control with operator control ventilatory support and therapy with large number of cases to prove safety, reliability and usefulness of AI controlled mechanical ventilation in shortening ICU length of stay and duration of mechanical ventilation and not causing ventilator induced lung injury.

We should wait for introduction of new AI controlled ventilation mods and proving their safety and efficiency in clinical practice. Until that time, it seems it is logical to adjust ventilator by ourselves.

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