Review of: "Non-invasive positive pressure ventilation versus endotracheal intubation in treatment of COVID-19 patients requiring ventilatory support"

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Commentary on Non-invasive positive pressure ventilation versus endotracheal intubation in treatment of COVID-19 patients requiring ventilatory support

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"Insanity is doing the same ineffective thing again and again and expecting a different result." --- Albert Einstein

Daniel et al. reported an 84% mortality for COVID-19 patients going from NIV to intubation[1]. When there is 84% mortality, and patients are medically sedated to unconsciousness before they die, there is not much to lose by trying something different. Neither in the Daniel et al. publication, nor in any others that we have seen that concern "NIV" for anyone, are the NIV settings noted. Daniel et al. should be complemented for at least listing this as a "limitation."

"NIV" has come to be synonymous with continuous positive airway pressure (CPAP) and low span bi-level PAP to titrate away central and obstructive apneas during polysomnograms that are not programmed to interpret such events as being due to respiratory muscle weakness or ventilatory failure. However, there is a big difference between low and high span bi-level PAP. High inspiratory and expiratory PAPs would be considered more likely to increase risk of lung damage and barotrauma but might better keep airways open. Interestingly, the medical literature suggests a lack of correlation between levels of end-expiratory pressure delivered by varying NIV settings, and incidence of barotrauma[2]..High bi-level spans, spans greater than 15 cm H2O, however, might not only better rest respiratory muscles, but relieve tachypnea, dyspnea, and more normally ventilate lungs rather than using NIV for "permissive hypercapnia". Since mortality of 70-85% is so extremely high with or without NIV, and since pneumothoraxes are treatable using chest tubes, maybe higher settings, that is, noninvasive ventilatory support (NVS) settings or spans of 15 or more cm H2O, should be tried for at least the subset of the COVID-19 population whose lungs can be ventilated at much less than typical adult respiratory distress syndrome (ARDS) levels. NVS settings have now been used for full continuous ventilatory support (CNVS) via mouthpieces since people left Iron Lungs in 1954, even though many have little to no vital capacity[4]. Such settings can, therefore, provide up to full ventilatory support and respiratory muscle rest, at least for patients using who do not have primary lung disease.

NVS settings for our patient populations are preferably volume preset assist-control mode via mouthpieces and active ventilator circuits at 650 to 1400 ml or pressure assist-control ventilation at 18-24 cm H2O. Positive inspiratory pressures (PIPs) up to 55 cm H2O can be required to normalize CO2 levels for some morbidly obese patients[5]. High bi-level spans using passive ventilator circuits, similarly of over 15 cm H2O, can also be used for "ventilatory support." They, too, should better oxygenate blood and relieve dyspnea, tachypnea, and possibly avert obtundation and coma, perhaps for at least a subset of COVID-19 patients.

There are two reasons for severe dyspnea in these patients. They are hypoxia that is treated by high flow oxygen (O2), and hypercapnic ventilatory failure that is normally treated by invasive mechanical ventilatory support (IMV). What few physicians realize, however, is that hypercapnic ventilatory failure, even for patients who are apneic with 0 ml of vital capacity, can invariably be completely relieved and alveolar ventilation fully supported by open circuit noninvasive positive pressure ventilatory support (NVS) including for people with little to no VC due to high level spinal cord injury, neuromuscular diseases, acute crises of myasthenia gravis, etc.. This is not always the case for people with upper motor neuron diseases that cause upper airflow obstruction or with severe lung disease that necessitates high fiO2 that increases air leakage via open circuits[6]. When normal oxyhemoglobin saturation is maintained by high flow O2, hypoxic drive is reduced, NVS leaks, and CO2 levels increase often to the point of coma[6]. Our centers have an essentially 100% success rate at extubating and decannulating people having no ventilator free breathing ability, the latter who unnecessarily underwent tracheotomies but who might have been managed by NVS and MIE instead[7] [8][9].

Unfortunately, COVID-19 is a condition in which oxygenation impairment predominates over ventilation impairment. In fact, the ability to ventilate the lungs usually returns sooner than the ability to oxygenate the blood without supplemental O2. Because of the severe hypoxemia in COVID-19, NVS to treat ventilatory pump failure (VPF) would need to be provided via oronasal interface for an essentially closed system of NVS. COVID-19 patients who undergo tracheotomies can be decannulated of tracheostomy tubes when they are either strong enough to ventilate their lungs but require O2 or no longer require O2 but only ventilatory support. It is possible to routinely decannulate patients with no ability to ventilate healthy lungs and normal oxyhemoglobin saturation levels[8][10] [11]

While there are similarities between COVID-19 and ARDS, there are also differences. For example, some patients' CO2 levels can be lowered by delivering PIPs lower than is typically observed in ARDS. While there are numerous publications reporting lung damage, barotrauma, and increased mortality rates associated with ventilatory support settings for people with ARDS, high bi-level spans or using ventilators with active ventilator circuits have only been reported in Germany to avoid severe hypercapnia, coma, and significantly lower intubation rates for patients COVID-19 [12]. For the COVID-19 patient not requiring high PIPs to ventilate their lungs, NVS settings might be especially effective at averting intubation.

Until recently, fear of barotrauma, and failure to understand that ventilatory support can be provided via noninvasive interfaces, resulted in only CPAP and low span bi-level PAP being provided for people with chronic obstructive pulmonary disease (COPD). Over the last few years, NVS settings with drive pressures averaging 23 cm H2O in some studies have demonstrated greater survival than using low span (NIV) settings[13] [14] [15] [16] [17][18] and without a greater incidence of barotrauma. The better outcomes are thought to stem from improved cardiac viability and heart rate variability[19] as well as by better resting respiratory muscles. The same might be true in the treatment of at least a subset of COVID-19 patients who have relatively preserved lung compliance. German physician Dr Gurt Laier-Groeneveld reported significantly decreased intubation rates in COVID patients using NVS settings delivering 900 ml volumes[12]. He reported that using NVS settings, albeit at higher pressures, intubation rates can be significantly decreased without significantly greater barotrauma even though there are reports of increased barotrauma by using higher ventilator settings for patients with non-COVID-19 ARDS[20]. We have also reported using NVS in combination for mechanical insufflation exsufflation (MIE) at high expiratory pressures to successfully decannulate COVID patients[21]. Dr. Laier-Groeneveld's findings suggest that the risk/rewards of using higher spans of bi-level PAP should be reconsidered under the backdrop of COVID respiratory failure.

While fear of increasing lung damage and barotrauma by using high bi-level spans is reasonable for people with COVID-19, it may not cause mortality to exceed the already high 84% levels reported in the Daniel et al. paper, especially for those with relatively compliant lungs that can be safely ventilated by typical NVS settings at PIPs of 15-25 cm H2O to relieve dyspnea. Perhaps some, like the COPD patients that we now know can tolerate NVS settings[22] (to 24 cm H2O), these can ease tachypnea and dyspnea, and avert intubation. I, for one, would not want to be medically sedated to coma if there were any possibility of avoiding that by full NVS.

In addition, the authors also pointed out that CPAP and "BiPAP" aerosolize virus that can infect the staff. However, patients can use a non-vented oronasal interfaces with an active (not passive) circuit, one with an exhalation valve that can be capped with a filter so that the staff is essentially entirely protected. Further, in their publication, disease severity was not stratified by indicating extent of need for O2 or VC.

Further, the authors note that use of bi-level PAP may help preserve the supply of ventilators. However, bi-level PAP, used at NVS settings, is used as a ventilator. Therefore, NVS can be provided via active circuits and non-vented noninvasive interfaces (mouthpiece, nasal and oronasal interfaces, masks, and helmets), passive circuits using high span bi-level PAP, as well as invasive interfaces (translaryngeal and trach tubes). Thus, we suggest that NVS settings via noninvasive interfaces should, at times, be considered for subgroups of COVID-19 patients. What is there to lose?

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