Limitations of Ventilating Multiple Patients Using Single Ventilator during the COVID-19 Pandemic

Sir,

The shortage of ventilators due to the present COVID-19 pandemic is a great challenge for several countries, including India. Within the medical infrastructure, there are critical technologies that are generally available, but simply do not exist in a high enough density to handle the excessive volume of patients associated with the pandemic. To face the upcoming situation, a single ventilator can be modified to provide ventilatory support to five patients or more with similar lung mechanics.[1] The first modern descriptions of multiple patients per ventilator were reported by Neyman and Irvin in 2006.[2]

We acknowledge the fact that shortage of ventilators during the COVID-19 pandemic is a challenge in several countries, including India. Nevertheless, the pathophysiology of acute respiratory distress syndrome in patients with COVID-19 is complex, thus requiring individualized attention to the ventilatory strategy applied with regular reassessment and adjustments. There are two types of COVID-19 lungs, and these are L- and H-type lungs. The L-type low elastance case has nearly normal compliance, which indicates that the amount of gas in the lung is nearly normal. The Type H high elastance cases have hypoxemia, bilateral infiltrates, decreased respiratory system compliance, increased lung weight, and potential for recruitment.[3] For this reason, if patients are to be connected to the same ventilator, they should have the same type of compliance. Otherwise, the patients with high elastance may suffer because of this procedure.

Therefore, there are several challenges in ventilating multiple patients using a single ventilator. These challenges are classified into three main headings, and they have been listed below:

Initial settings

1. The tidal volume would be delivered preferentially to the most compliant lung segments irrespective of the mode of mechanical ventilation applied.
2. The added circuit volume interferes with the initial self-testing of the ventilator. Hence, one may have to operate the ventilator without passing a successful test, which will further add to the errors in the measurement of ventilator parameters.
3. Managing positive end-expiratory pressure in these patients is challenging.

Monitoring

1. Monitoring individual patient pulmonary mechanics will be difficult. Both diagnostic and recruitment ventilator maneuvers would be challenging to practice on a single patient.
2. Ventilatory alarm monitoring and its management will be challenging.
3. Individualized assessment for clinical improvement or deterioration and further management will be difficult. In the event of a cardiac arrest in any ventilated patient, the ventilation to all patients would need to be immediately changed and during cardiopulmonary resuscitation, it may increase the chances of aerosolizing the virus. This increases the risk of infection to the health-care workers and simultaneously it may alter the breath delivery dynamics to the other patients.
4. With the use of this assembly using a single ventilator, the monitors will show the average pressures and volumes.

Troubleshooting

1. In the initial phase of ventilation even if all patients have similar clinical features, they may deteriorate and recover at different rates, and distribution of gas to each patient would be unequal and unmonitored
2. If there is a sudden deterioration in an individual patient, resulting in an increased resistance or decreased compliance during mechanical ventilation, for example, due to pneumothorax, kinked endotracheal tube, and endotracheal tube obstruction, the ventilation distributed to the other patients may get affected
3. Some ethical issues are also there, as use of a single ventilator can be lifesaving for a single individual, and simultaneously if it has been used for ventilating more than one patient at a time, it may have life-threatening risks.

There is no human data available till date and so its routine use cannot be endorsed. This is meant to be a stop-gap measure or a desperate measure to tide over the crisis of ventilatory requirements in this COVID-19 pandemic. However, if at all, it must be kept as a last resort to buy time for a limited period because it may cause more harm than good. First of all, cause no harm!

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Conflicts of interest

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