Introduction

COVID-19-induced acute respiratory distress syndrome (ARDS) resulted in a health care resource crisis especially in terms of the number of ICU beds both in the developing and developed countries. Infection among health care staff and efforts to optimize the utilization of trained staff resulted in manpower shortage which took a significant toll on physical and mental health of the staff, taking care of the COVID-19 patients. Non-invasive ventilation (NIV) as well as High flow nasal oxygen (HFNO) has been extensively used for the management of moderate to severe COVID-19 infection despite initial concerns on high aerosol generation.1 We describe a case series where NIV was offered outside the intensive care unit (ICU) in the COVID dedicated hospital ward (CDHW) which was managed by the trained ward staff and non-intensivists.

Case Series

The patients presented with features of moderate to severe COVID disease (Influenza like illness) were managed in the COVID-19 ward. Apart from general and COVID-specific measures, we started Continuous Positive Airway Pressure (CPAP) trial for these patients. All these patients were weaned off CPAP and were discharged once they recovered.

Discussion

Limitation of bed numbers in ICU has caused unforeseen stress upon the system to manage sudden increase of severe acute respiratory distress syndrome during COVID pandemics. Studies have shown non-invasive ventilation (NIV) and high frequency nasal cannula (HFNC) have improved patient outcomes. But managing NIV and HFNC is resource intensive in terms of manpower and equipment. We have found that patients with severe COVID disease can be managed safely using CPAP in secondary care with minimal training of non-intensivist healthcare workers in a cost-effective and efficient way of treating severe COVID who are unlikely to worsen. Conclusion: With the imminent third COVID wave looming, it is high time to strengthen our existing primary and secondary health care system by these novel methods to reduce the burden of our tertiary care.

Keywords: COVID ARDS, CPAP, secondary care India
COVID dedicated hospital ward (CDHW) by the trained ward doctors and ward nurses. Patients apart from Continuous Positive Airway Pressure (CPAP) management, medical management, general measures, and monitoring were done as per the hospital COVID protocol (Broad spectrum antibiotic, low molecular weight (LMW) heparin, Dexamethasone, and Remdesivir). As these patients became better, they were given trial with 40% FiO₂ Venturi mask and once they tolerated it, they were shifted to normal beds. Once they have recovered and oxygen is not required, they were discharged and followed up on Outpatient (OPD) basis. Further details of the patients were shown in the Table 1.

Discussion

Patients with moderate to severe COVID-19 infection need oxygen therapy to manage hypoxemia secondary to atypical ARDS. The respiratory support to administer oxygen therapy ranges from noninvasive to more invasive approaches like invasive mechanical ventilation (IMV) and extracorporeal membrane oxygenation (ECMO).[3] The noninvasive oxygen therapy modalities include oxygen administration through simple face mask/nasal prongs, NIV, and HFNO therapy.[8]

Morbidity and mortality of COVID-19 patient with severe atypical ARDS who requires IMV is highly variable, and it ranges from 50% to 97%.[8] Limitation in the number of ICU beds in the developing countries causes significant strain on the tertiary care center (TCC) despite moving the CPAP to tertiary care ward from the ICU. India is heterogenous in the infrastructure of government run hospitals as the number of level 3 beds are scares compared to the population and the ICU beds are mostly in the cities. The cost of ICU beds in private hospitals is not affordable to most patients.

Multiple studies on HFNO[6,9] and CPAP[8] have shown that both were effective adjuncts in the management of acute hypoxemic respiratory failure secondary to moderate to severe COVID disease.[1,3] Apart from that, both have significantly reduced the need of endotracheal intubation in nearly one-third to two-third of moderately to severe COVID-19 patients.[8] HFNO unlike CPAP is relatively better tolerated by the COVID-19 patients without claustrophobia, but it is costlier than CPAP and it requires almost 40 to 60/min of oxygen flow.[4] The amount of oxygen supply at the community health center is limited unlike the tertiary care centers that uses either bulk cylinders or oxygen concentrators. This needs to be taken into consideration before choosing the oxygen therapy in patients with COVID-19 patients.

The course and the clinical manifestation after COVID-19 infection are highly variable. Epidemiological studies have shown that in general only 10% to 20% of the affected patients require hospitalization and out of which 3% to 5% require endotracheal intubation with IMV. Multiple factors were responsible for inadequate decentralization of patients reaching the tertiary center. The 3 major factors were COVID testing with RT-PCR is getting done predominantly in urban tertiary units, inadequate triaging at various level of health centers, and inadequate medical

| Case no | 1 | 2 | 3 | 4 |
|---------|---|---|---|---|
| Age     | 39 | 39 | 46 | 46 |
| Sex     | Male | Female | Male | Female |
| Vaccination status | Not Vaccinated | Not Vaccinated | Not Vaccinated | Not Vaccinated |
| Comorbid illness | Newly diagnosed insulin dependent type 2 diabetes mellitus | Newly diagnosed type 2 diabetes mellitus | Mixed connective tissue disease, Interstitial lung disease | Newly diagnosed Diabetes mellitus and Newly diagnosed Hypertension |
| ILI symptoms | Cough and breathlessness | Fever and cough | Fever and cough | Fever and cough |
| Duration | 3 days | 4 days | 5 days | 8 days |
| Respiratory system findings during admission | RR 116/min | RR 130/min | RR 28/min | RR 36/min |
| Chest X ray | B/L diffuse infiltrates | B/L diffuse infiltrates | B/L diffuse infiltrates | B/L diffuse infiltrates |
| PF before initiating NIV | 116 | 132 | 227 | 146 |
| Severity of illness | Severe COVID | Severe COVID | Moderare COVID | Severe COVID |
| Type of NIV | CPAP with 6 cm H₂O | CPAP with 6 cm H₂O for 2 days then stepped up to 10 cm H₂O for 7 days | CPAP 9 cm H₂O for 6 days | CPAP 8 cm H₂O for 1 day to 9 cm H₂O for 3 days |
| Duration of NIV therapy | 3 days | 9 days | 6 days | 4 days |
| PF after initiating NIV | 158 | 354 | 297 | 234 |
| D-Dimer | 1717 | 367 | 450 | 242 |
| Duration of hospital stay | 7 days | 19 days | 18 days | 8 days |
| Complications of NIV | Nil | Nil | Nil | Nil |
| Outcome | Discharged uneventfully and followed up in OPD | Discharged uneventfully and followed up in OPD | Discharged uneventfully and followed up in OPD | Discharged uneventfully and followed up in OPD |

[PF: ratio of ABG]
infrastructure at government health center (ranges from 18% at the sub-centre to 50% at community health centre (CHC) level).[8]

Health ministry of India recommends proper triaging of COVID patients as soon as possible, which dictates the further course of action. Poor segregation of patients into different categories often occurs as a result of lack of proper triaging system apart from panic among COVID affected patients. The result of which is that nearly two-third of COVID patients with mild infection which can be managed by simple home isolation, occupies the hospital bed with consequent limitation of beds who deserves admission.

Panigrahi et al.[9] have suggested COVID segregation based on the risk of progression unlike the ministry of health recommendation and conversion of at least 40% of CHC to dedicated COVID health centers with dedicated referral channel to TCC. The above measures will be able to provide additional 75,000 beds which help to limit the shortage of bed. But we feel the decentralization measures will be more effective if the NIV CPAP is moved out of the ICU into the dedicated COVID CHC and district hospital. We suggest of managing moderate to severe COVID patients which are less likely to progress to critical COVID, with NIV and proning in a level 2 care, as the case fatality rate of patients that does not require the ICU admission is almost zero.[8,14] This will ensure that elderly COVID patients, patients with poorly controlled comorbidity condition, and patients with rapid progression from mild to moderate ARDS with respiratory failure won’t be denied the ICU admission as such (First two category constitutes about 5% to 10%).[11,12]

There are two important roadblocks to move the CPAP outside the ICU from the intensivist perspective. The relative lack of knowledge of medical staff about NIV management and inadequate medical infrastructure often remain Achilles’ heel.[8]

Studies have shown that the lack of knowledge of working staff and doctors (at least 50%) in wards with regard to management of patients with NIV can cause reluctance in managing the patient with COVID infection. Training of the HCW on the use of CPAP by the respiratory physician/therapist/intensivist/nurse and by simulation at the tertiary care is much easier when compared with other modes of ventilation.[13] Case-based learning and discussion on indications and contraindications to CPAP, parameters that needs to be monitored, and indications to refer the patient to tertiary care centre with CPAP as a bridge to transfer can be demonstrated to HCW.

COVID-19 pandemic has given the strong signal finally to move the CPAP outside of intensive care to the wards of the CHC and district hospital. CPAP can be readily used in wards of CHC and district hospital not only as bridge to recovery but also as bridge to transfer to tertiary care.[13] We feel that this will the simple and most cost-effective approach to decentralize the COVID patients swarming the tertiary care.[14] Also, the CPAP that is purchased at the CHC won’t remain useless after the COVID epidemic, as it can be used to treat other respiratory distress that are common in India, such as COPD exacerbation, Cardiogenic pulmonary oedema, etc.

With the imminent third wave in the coming months, thinking of a worst case in mind, a strategy needs to be devised to manage the patients who would require respiratory support. COVID despite its impact on health care system has given the window of opportunity to strengthen from top to bottom of public health care system by improving the medical infrastructure, and this opportunity should not be missed.

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Conflicts of interest

There are no conflicts of interest.

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