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Oxygen delivery devices in Covid-19 patients: An observational study on Indian population

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Abstract

Introduction: Covid-19 pandemic has affected the whole globe creating acute respiratory distress syndrome (ARDS) in especially aged patients with chronic illness. Oxygen therapy is the main stay of management strategy. Different oxygen delivery devices are required to be reviewed for current pandemic situation.

Objective: To rationalize the use of oxygen delivery devices on Indian population

Method: In this study 100 patients diagnosed with Covid-19 viral pneumonia requiring multicomponent oxygen therapy in intensive care unit were taken. On admission their baseline oxygen saturation (SPO2) and arterial oxygenation (PaO2) along with chest x ray finding were taken and according to the severity of the condition step wise multicomponent oxygen therapy was used. Improvement in oxygen saturation, patient compliance and aerosol generating property of each device was assessed. And recommendation guidelines were made to rationalize the management protocol for future patients

Results: Out of total 100 patients, 67.3% were male and 32.7% were female. 52 patients were hypertensive, 34 were diabetic, 13 were chronic kidney disease, 3 were having ischemic heart disease. 57.6% patients had moderate ground glass opacity while 31.3% had mild involvement of lung. 11.1% had extensive bilateral ground glass opacity in chest x ray findings. 39 patients were optimized using NRBM, 27 were requiring HFNC to maintain oxygen saturation above 90% which was the cut off value set in our treatment protocol. 22 patients were requiring NIPPV using BiPAP mask. And 7 were on simple oxygen mask. 5 patients were on invasive mechanical ventilator via endotracheal tube. 5 patients died while on treatment out of which 4 were on IMV and 1 was on NIPPV.

Conclusion: Use of multicomponent oxygen delivery devices should be individualized according to patient's needs, availability and compliance for the best outcome in pandemic situation

Keywords: Covid-19, Oxygen, Viral pneumonia, Oxygen delivery device, Oxygen saturation (SPO2)

Introduction

Covid-19 is a respiratory virus causing breathing related problems in especially geriatric and co morbid patients[1]. Covid-19 viral pneumonia along with respiratory distress syndrome is the major complication of Covid-19 requiring oxygen therapy as a main stay of treatment. Various oxygen delivery devices are available starting from simple oxygen mask, non-rebreathing mask (NRBM), high flow nasal oxygen (HFNO), noninvasive positive airway pressure (NIPPV), intubation and invasive mechanical ventilation (IMV)[2]. Usage of all these measures require special training for better outcome of patient. Guidelines should be made for proper management and training of all staff in pandemic situation[3]. Patient's compliance, tolerability, availability and so many other factors affecting the outcome of oxygen delivery devices should be taken into consideration while making the rational approach. Weaning from oxygen therapy also need a step down approach [3]. In this article we tried to cover the treatment strategy for our patients from single center in terms of feasibility and outcome.

Method

100 patients diagnosed with Covid-19 viral pneumonia patients admitted to intensive care unit from October 2020 to November 2020 of two months duration requiring oxygen treatment were taken into study. On admission to intensive care unit baseline vitals and oxygen saturation was taken. chest x ray was advised for assessment of severity. Oxygen therapy started as per requirement and guideline with the lowest possible and titrated to higher device. The cut of value for successful outcome SPO2 should be 90% as universally accepted in clinical practice. As per the clinical presentation oxygen delivery device was administered. Step up and step down approach regarding oxygen delivery device was decided 30 mins after the application of primary oxygen device. If patient was unstable as per clinical condition higher grade device was immediately given. Data collected in terms of demographic profile, SPO2 on admission and after application of each oxygen delivery device, chest X ray findings, complications, outcome of the patient in terms of discharged from ICU.

Results

Mean age of the patients admitted to intensive care unit was 62.1 years. Out of total 100 patients, 67.3% were male and 32.7% were female as shown in pie chart 1. Majority of the patients requiring oxygen therapy were co morbid like 52 patients were hypertensive, 34 were diabetic, 13 were chronic kidney disease, 3 were having ischemic heart disease (as shown in chart 2). As per chest x ray finding suggest 89 patients presented with mild to moderate lung involvement versus 11 presented with bilateral extensive ground glass opacities (as shown in chart 3). 39 patients were optimized using NRBM, 27 were on HFNO to maintain oxygen saturation above 90%, 22 patients were requiring NIPPV using BiPAP mask. 5 patients were on invasive mechanical ventilator via endotracheal tube (as shown in chart 4). 5 patients died while on treatment out of which 4 were on IMV and 1 was on NIPPV (as shown in chart 5).

Discussion

Maintenance of oxygen saturation is the key factor in the successful outcome of the patient with Covid-19 viral pneumonia. In pandemic the patient flow is very high so proper guideline is essential for the better outcome of the patient. Simple oxygen mask is the primary device which can deliver FiO2 maximum up to 40% with 4-6 liters of the humidified oxygen. It is the

first device that can be administered in clinically stable but hypoxemic patient whose breathing efforts are good and work of breathing is not so high. Outcome of any oxygen device can be quickly measured within 15-30 mins with improvement in SPO2 of the patient. The cut of value for successful outcome SPO2 should be 90% as universally accepted in clinical practice[4,5].

NRBM has the reservoir bag which can deliver FIO2 from 80 to 100% with 10-15 liters of humidified oxygen. It can be reserved for the patients not maintaining SPO2 with simple oxygen mask with high work of breathing (as per figure 1).

Higher level of device like HFNO with 40-60 liters of humidified oxygen is reserved for patients who are refractory to the treatment with above two devices (the whole assembly is shown in figure 2). As per one study on Italian cohort, HFNO can delay invasive mechanical ventilation in patients with respiratory failure but no hypercapnia[6]. Only disadvantage is that it can generate lot of aerosols and so can be used with surgical mask applied on patient with device as shown in photograph 1. It can deliver FiO2 up to 100%. One disadvantage is flow is so high which can cause extreme dryness and bleeding in nasal mucosa already coagulopathic patient due to severe inflammation secondary to covid-19 infection[7]. Last modality is mechanical ventilation. Which has 2 types, non-invasive and invasive. Noninvasive ventilation with BiPAP mask has lot of advantage of prevention of ventilator associated pneumonia and secondary bacterial infection. But require lot of moral support for the patient on continuous basis[8]. As well as lot more aerosols can be generated as a part of multiple times removal of the mask for oral intake of medicines, food and liquid (as per shown in figure 3). Ultimately intubation and invasive mechanical ventilation is reserved as a last sort of management protocol refractory to all above treatment[9].

In our unit, patients on NIPPV were requiring constant psychological support to continue with the treatment as so much pressurized air was delivered through ventilator. 1 patient on NIPPV and 4 patients who were on IMV were died while on treatment due to ARDS secondary to covid-19 pneumonia and respiratory failure.

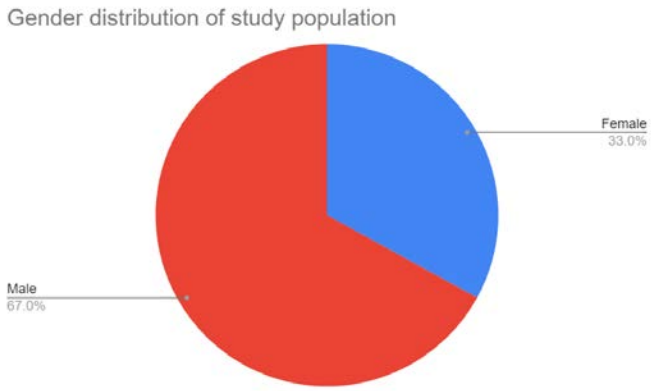
Oxygen therapy with limited resources is really very challenging in pandemic situation. Resource management and special training is the key factor for successful outcome of patient admitted in intensive care unit in covid-19 pandemic. Variety of presentation and clinical spectrum of covid-19 viral pneumonia requiring oxygen therapy should be rationalize according to institutional availability and training[10]

Conclusion

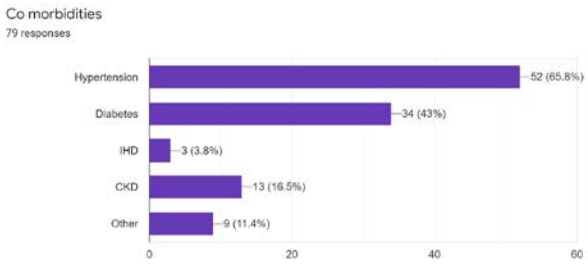
Use of multicomponent oxygen delivery devices should be individualized according to patient's needs, availability and compliance for the best outcome in pandemic situation

Figures and charts:

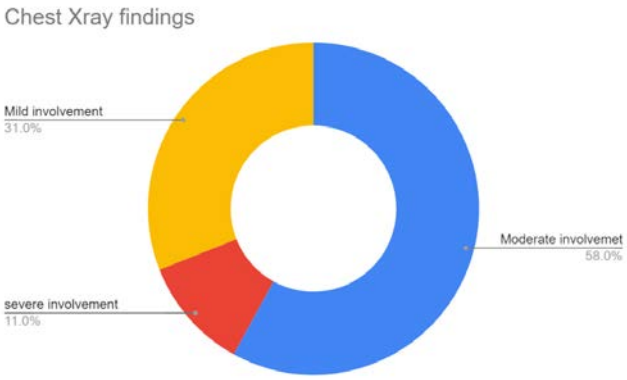
Graph 1: Showing gender distribution of study population



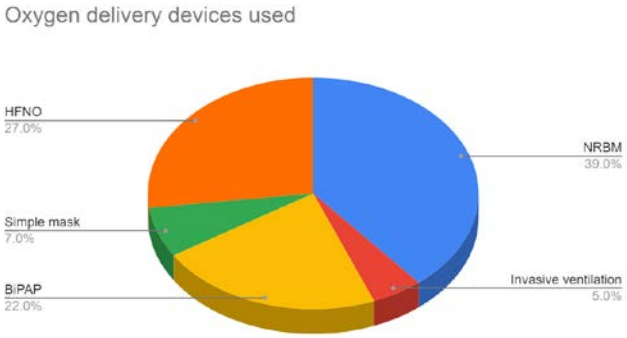
Graph 2: showing graphical distribution of co-morbidities of study population



Graph 3: Chest X-Ray findings of study population-on admission



Graph 4: Oxygen delivery devices used at a time in intensive care unit



HFNC: High flow nasal oxygen

NRBM: Non rebreathing mask

Graph 5: Outcome of study population in intensive care unit

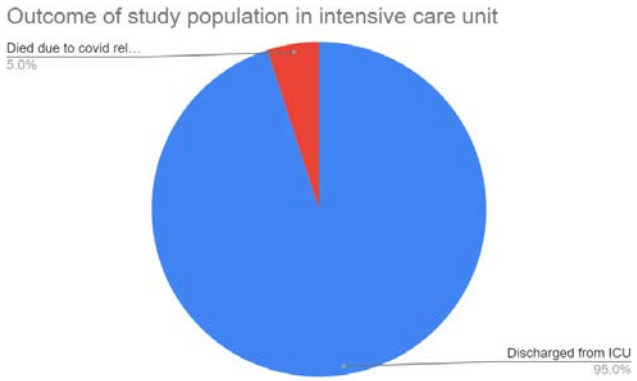


Figure: 1 showing NRBM application on study case

Figure: 2 showing HFNO application on study case

Figure 3: showing NIPPV on study case

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