HCFI Dr KK Aggarwal Research Fund

Minutes of an International Weekly Meeting on "Oxygen Therapy"

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August 19, 2023 (Saturday, 9.30-10.30 am)

- COVID has taught us the importance of oxygen. The best way to know if the patient requires oxygen is to measure the oxygen saturation (SpO_2). A healthy person will have a SpO_2 of ≥97%. If SpO_2 is <94%, this means that there is a moderate to severe disease and oxygen has to be administered. If the SpO_2 is 94% to 97%, this indicates some limitation, but can be managed and oxygen supplementation may not be required.
- Features of lack of oxygen in the body are tachypnea (RR >24), use of accessary muscles, unexplained tachycardia, pale and cold peripheries, sweating, confusion, agitation, reduced consciousness and cyanosis (peripheral [seen on nail beds] and central [seen on lips]).
- The various sources of oxygen are liquid oxygen tanks in large hospitals, oxygen cylinders in smaller hospitals, and oxygen cylinders with flowmeters attached are used in wards. At home, oxygen concentrators are used; but, as the flow increases the purity decreases.
- The pressure in the pipeline is 50 psi. This has to be reduced to 14.3 psi to be deliverable to the patient. There is a flowmeter to control the oxygen amount and also reduce the pressure. Compatible wall outlet and flowmeter are required.
- These flowmeters usually give a flow of 1-15 L/min which is usually sufficient for mild to moderate requirement.
- The upper surface of the bobbin displays the flow but one must always look at the flowmeter as there are different types of bobbins, which indicate different levels of flow. Some read at the top, some in the middle.
- There are various devices, which can be connected to the flowmeters. These include the simple face mask, partial/nonrebreathing mask, venturi mask, high-flow nasal cannula (HFNC), continuous positive airway pressure (CPAP) and bi-level positive airway pressure (BiPAP) (noninvasive ventilation [NIV]), invasive ventilation (ventilator), extracorporeal membrane oxygenation (ECMO) and hyperbaric oxygen therapy (HBOT).
- Simple face mask is the most commonly used device to deliver oxygen. It is used in mild cases, where the SpO_2 is ~94%. Up to 10 liters can be given with this. Start with minimum flow of 5 L/min. If <5, then over time there will be accumulation of CO_2. With a simple face mask, the maximum FiO_2 of 0.4 (40%) can be given. This is very patient dependent; if the patient is very tachypneic, the requirement is very high and then the amount of oxygen delivered will go down.
- Nasal cannula is also used for mild cases where the SpO_2 is ~94%. This is more comfortable as the patient can talk, etc. In some cases, irritation, bleeding, crusting can occur. With this up to 6 L of oxygen can be given but is usually kept at 2-4 L/min. Start with a minimum flow of 2 L/min. The nasal cannula can deliver a higher FiO_2 (0.45) than the face mask. It is again patient dependent.
- With simple face masks and nasal cannula, always administer humidified oxygen. Dry oxygen is uncomfortable for the patient.
- The nonrebreathing mask is like a simple face mask, but with an oxygen reservoir attached and it has unidirectional valves. Almost up to 90% oxygen can be given (FiO_2 0.80-0.90). Use a fresh gas flow (FGF) of 10-15 L/min. It is patient dependent and the bag should always remain inflated.
- The partial rebreathing mask is similar but without valves. Maximum of 60% to 80% oxygen can be given. Use a FGF up to ≥8 L/min. When the patient is breathing, some amount of air can enter and dilute the oxygen.
- Venturi mask is used in mild to moderate cases; 5-15 L/min can be given. It delivers oxygen at an FiO_2 varying from 0.3 to 0.6. There are gradations and the flow can be adjusted by rotating it. With this, the percentage of oxygen that is being given to the patient can be titrated to maintain an acceptable target saturation that has been set for the patient. It does not depend on patient effort.

- High-flow nasal oxygenation (HFNO) is used for moderate to severe cases. It is a bridge between Venturi and higher requirement of oxygen (NIV/invasive ventilation). It can provide up to 100% oxygen. One can precisely regulate the amount of oxygen that is given. Up to 80 L/min oxygen can be delivered.
- Such high flow of oxygen will keep the airway open and alveoli open. It decreases the work of breathing and because of humidification, it prevents dryness.
- With HFNO, the patient can move about, talk and self-feed. Provides positive end-expiratory pressure (PEEP) 5 to 8 cmH_2O. The patient can put in prone position as it fits snugly on the face.
- Contraindications of HFNO are poor Glasgow Coma Scale (GCS), severe respiratory distress syndrome (RDS), cardiovascular system (CVS) instability, airway obstruction, inability to cough. Spread of infection is a concern.
- Attach the device to flow meter or high-pressure oxygen outlet. Start with flow of 60 L/min with FiO_2 of 1.0. Depending on the patient response, the FiO_2 can be reduced and then the flow. Once the flow is 10-15 L, then switch over to other simple devices.
- NIV is used for moderate to severe cases. It is useful for asthma and chronic obstructive pulmonary disease (COPD) patients. It is a bridge for mechanical ventilation. The mask has to be tight fitting for it to be effective. Pressure on the nose bridge is one of the major complications.
- There are two modes of NIV: CPAP and BiPAP.
- In CPAP, start with 10 cmH_2O @ FiO_2 0.6 and then it can be upgraded. It maintains constant flow at a pressure, which is the same during inspiration and expiration. It prevents alveolar collapse and improves gas exchange.
- BiPAP is used commonly in COPD. The pressure can be varied in inspiration and expiration (IPAP 12-35 cmH_2O and EPAP 5-12 cmH_2O).
- NIV is the first choice in severe acute respiratory distress syndrome (ARDS). A prior chest X-ray is advisable as it can cause pneumothorax. It is considered the ceiling in end-of-life care. If the situation worsens, intubate and initiate mechanical ventilation.
- There are two types of masks for NIV. One has ports for expiration, while the other type has not expiration ports or exhalation holes. If masks with exhalation port is used in the 2-limb circuit ventilator, the pressure will never be achieved. There will be a constant leak from the exhalation valve. If the masks with no holes are used, the patient cannot exhale through the port at all. This was the major cause of pneumothorax during COVID due to the high pressure.
- Helmet based NIV uses a well sealing helmet. It is comfortable for the patient and permits mobility. It is as effective as a mask or nasal cannula. Claustrophobia is a disadvantage.
- Invasive ventilation is needed in patients with severe ARDS (PaO_2/FiO_2 <200), the patient is unconscious, SpO_2 is low after all the above methods and hemodynamics and tachypnea are not settling. If the patient is in shock, then invasive ventilation is advisable.
- ECMO is indicated in very severe ARDS where lungs have failed, there is severe infection, when the maximum setting of the ventilator has been reached to maintain oxygen. There are two types: venovenous and arteriovenous. It requires heparin and protamine infusions. It is a very specialized equipment and is to be used by intensivists.
- HBOT is delivers oxygen at high pressure in a specialized chamber. It is commonly used for BENDS. Oxygen used is 2 atmospheres for 95 minutes and is delivered in 3 to 8 sessions. The increased pressure surpasses the thickened alveolar membrane and improves oxygenation.
- Complications of oxygen therapy include oxygen toxicity, depression of ventilation, retinopathy of prematurity (in neonates), absorption atelectasis. Too much of oxygen is a fire hazard.
- Do not give 100% oxygen for more than 2 hours; 80% for not more than 24 hours and 60% for not more than 36 hours. The goal should be to use the lowest possible FiO_2 compatible with adequate tissue oxygenation.
- The humidifier should be disinfected regularly. The water should be changed.
- Too much of oxygen is agitating and gives a "high".
- Rather than treating the numbers (SpO_2), treat the patient. It is the patient who will tell you if he/she is better.
- There should be some ingress of fresh air in the room where the oxygen concentrator is used to replenish the air so that more oxygen can be concentrated.
- We should conserve the use of oxygen as it takes a toll on the environment. Oxygen concentrators

do not benefit the environment. Use only when necessary.

Participants – Member National Medical Associations: Dr Yeh Woei Chong, Singapore, Chair of Council-CMAAO; Dr Akhtar Hussain, South Africa; Dr Prakash Budhathoki, Nepal

Invitees: Dr Monica Vasudev, USA; Dr Monica Vasudev; Dr SK Malhotra; Dr Sanchita Sharma, Editor-IJCP Group

Moderator: Mr Saurabh Aggarwal

Round Table Environment Expert Zoom Meeting on "New Study on Relationship Between Air Pollution and Antibiotic Resistance – Part 2"

September 3, 2023 (Sunday, 12 noon-1 pm)

- The negative effects of air pollution are well-known, especially in the Indo-Gangetic plain, where the PM2.5 levels usually exceed 500 μg during the winter months. Sometimes, they may reach even up to 900 or higher.
- The World Health Organization (WHO) has recommended PM2.5 target of 5 $\mu g/m^3$.
- This study showing an association between PM2.5 and antibiotic resistance has been published in *The Lancet Planetary Health* in August 2023.
- Antibiotic resistance is increasing globally and is causing millions of deaths worldwide every year. Antibiotic resistance caused nearly 1.27 million premature deaths globally in 2019.
- Data from 116 countries are used for this study from 2002 to 2018. A total of 11.5 million tested isolates were included in the final analysis.
- The study findings indicate significant correlation between PM2.5 levels and antibiotic resistance, which were consistent across the globe in most antibiotic resistant bacteria. Antibiotic resistance driven by PM2.5 caused an estimated 0.48 million premature deaths and 18.2 million years of life lost in 2018 corresponding to an annual welfare loss of US $395 billion due to premature deaths. The maximum effect was seen in West Asia and North Africa.
- This study has been done till 2018. It should have included the corona period also after 2018.
- Ten percent increase in annual PM2.5 levels could lead to 1.1% increase in aggregate antibiotic resistance and 43,654 premature deaths.
- If the WHO target of 5 $\mu g/mm^3$ of PM2.5 is reached in 2050, this will reduce antibiotic resistance by 16.8% and avoid 23.4% of premature deaths attributable to antibiotic resistance which is equal to saving of $640 billion. Achieving this task is very challenging, especially in the Indo-Gangetic plain.
- A new study by the Energy Policy Institute at the University of Chicago has shown an association between PM2.5 and years of life lost. PM2.5 may cause 11.9 years lost in life expectancy on average. This also declared Delhi as the most polluted city in the world. In Gurgaon, the decrease in life expectancy was 11.2 years, Faridabad 10.8 years and Ghaziabad 10.7 years.
- *The Lancet* study shows that air pollution is also a mode of transport of antibiotic resistance among the public and also in animals.
- Earlier most respiratory problems were curable with low doses of antibiotics, but now there is a need for prescribing broad-spectrum antibiotics as well as higher doses of antibiotics, which raises a question as to why this is happening.
- Antibiotics are now being used in farming, etc. It is introduced in the soil through pharmaceutical waste products, which then gets into the air and water.
- Lifestyle changes, use of face masks in public spaces, air purifiers at home (if affordable) are needed to control this. It also requires to be tackled at the government level.
- Not just the government and public authorities, public contribution and support is also very important.
- Composition of PM2.5 is more important than the size. Vehicular emissions contain metallic and other organic compounds, which are toxic. Vehicular emissions and roadside resuspended dust are more of a problem in the urban areas than in rural areas. Urban areas are more polluted with carbon monoxide.
- It is not clear if the new study has taken the composition of PM2.5 into consideration.
- The inhalable part of PM2.5 is a combination of monoxides, especially carbon monoxide. The metals, organic compounds, zinc, arsenic, magnesium, copper, sulfur, toxins and pollens attach to the PM2.5, which then becomes a breeding ground for bacteria to grow within it and become a carrier.
- It has always been thought that antibiotic resistance was only due to overprescribing of antibiotics by doctors or having foods which have been treated

with antibiotics. But now this study suggests that air pollution is also a source of antibiotic resistance. This is very alarming as finding pure air to breathe is not easy. However, overuse of antibiotics needs to be monitored and checked.

- Increasing natural vegetation or greening is one way to reduce air pollution. Home gardens should be encouraged.
- Wearing face masks, as per the area traveling to, will be the first aid to prevent respiratory conditions. Gargling when reaching home, handwashing, cleaning the nose (netineti) are other measures that will help. Quitting smoking is very important.
- Air purifier, if one can afford, would be ideal to keep the environment clean at home.
- There is also now a transition to electric vehicles.
- Take treatment as soon as symptoms of cold and cough develop. Home remedies (ginger, dashamoola) can be used to improve lung health.
- However, lifestyle changes are becoming more and more difficult to adopt because of the increasing consumerism.
- The focus has always been on PM2.5 rather than ultrafine particles. Studies try to link all health problems with PM2.5 as it is an easy target. Ozone, benzene, volatile organic compounds (VOCs), nitrogen oxides (NOx) are not talked about.
- PM2.5 increases cell permeability as it is a fine particle.
- Research into geographical-based differences in immunity is required.
- Controlling the source of emissions will help, if sources are known.
- A change in attitude of all stakeholders is imperative. Until tough rules are laid down, managing fine and ultrafine particles is very challenging in the urban areas, regardless of the source.
- Doctors who overprescribe antibiotics are often blamed for antibiotic resistant illnesses, but now research has pointed out another potential culprit.
- Until now, there was no clear picture of the possible links between the two, but this study suggests two benefits of controlling air pollution. One, not only will it reduce the harmful effects of poor air quality, it could also play a major role in combatting the rise and spread of antibiotic-resistant bacteria.
- The Delhi Pollution Control Committee (DPCC) in collaboration with IIT Kanpur is conducting a real-time source apportionment study. This will tell us the real-time sources of air pollution, which then can be managed accordingly.
- Most of the world population lives in areas where emissions exceed health standards.
- PM2.5 particles carrying antibiotic resistant bacteria, which when inhaled by humans or animals, may cause spread of antibiotic resistance. However, more research is needed.
- Animal and agriculture industry is another major driver of antibiotic resistance. Farmers often use antibiotics preventatively to prevent infections and to induce growth.
- The widespread use of antibiotics among livestock accelerates spread of antibiotic resistance in farm bacteria, which can then spread throughout the broader environment.
- It is important that people begin to acknowledge that this is a viable path for transmission of antibiotic-resistant bacteria in the environment.
- Controlling air pollution might lead to substantial health and economic benefits. Prolonged illnesses reduce productivity and affect GDP.
- State pollution control boards should better utilize the funds allotted. Focus should be on planning.

Participants: Dr Anil Kumar, Dr Azam Kabir, Dr SK Gupta, Mr Neeraj Tyagi, Mr Pradeep Khandelwal

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