

Significant physiological impact of wearing PPE inside operation theatre: A challenging scenario in this COVID-19 pandemic

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ABSTRACT

Owing to COVID-19 pandemic, wearing personal protective equipment (PPE) and N95 mask inside an operation theatre has become a common practice. Subjective symptoms of suffocation, headache, dizziness, and lack of concentration while on PPE may at times become significant enough requiring oxygen therapy, removal of mask, or even doffing of PPE, which may increase the risk of being infected and at the same time compromising patient care. The reason behind such subjective symptoms may be multifactorial. We report here a 52-years-old anesthetist with a high body mass index, wearing PPE for a prolonged duration inside an operation theatre during a high-risk surgery encountered a similar episode. Being the lone anesthetist, he decided to oxygenate himself in an innovative way, thus, avoiding doffing and any undesirable event. With pandemic expanding rapidly such scenarios may be encountered often, identifying factors predicting such events and finding methods of oxygenation while wearing PPE may be extremely beneficial.

Keywords: Body mass index, COVID-19, headache, hypercapnia, N95, operation theatre, oxygenation, PPE, suffocation

Introduction

A large number of doctors and health care workers have been infected globally while treating COVID-19 patients. Anesthetists, surgeons, and other staff are always at risk of contracting an infection while operating on COVID-19 patients for various elective, time-sensitive, and emergency procedures. In the absence of an effective vaccine and definitive treatment, personal protective equipment (PPE) has become the only available shield. However, wearing a PPE with an N95 mask and face shield may cause discomfort, headache, lack of concentration, restlessness, etc., In addition to reducing the speed of performing various skillful procedures such as intubation or intravenous cannulation, wearing PPE may cause ocular pain and exhaustion due to

reflection and refraction of light by the face shield.^[1] These factors along with difficult communications may affect patient care and compliance of wearing PPE.

Case Report

A 52-years-old senior anesthesia consultant was posted in cardiothoracic operation theatre (OT) along with two OT technicians for blalock-taussig shunt procedure in a 25-days-old neonate. Though tested negative for COVID-19, the baby had a contact history and was hailing from a containment zone, so full PPE along with an N95 mask with a surgical mask overlay and face shield was used by all the OT staff. Owing to lack of manpower and to cut OT gathering only one anesthetist was posted.^[2] Towards the end of the procedure, the anesthetist suddenly developed dizziness, restlessness, and mild headache. There was some degree of lack of concentration and tremor. Symptoms persisted even after removal of the surgical mask

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overlay and face shield. OT temperature was around 22°C. Going outside OT and doffing would have been a better choice, but being the lone anesthetist that option was not feasible. Before any further deterioration, the anesthetist took a prompt decision to oxygenate himself. He connected oxygen tubing to a flowmeter and inserted the same by the side of the N 95 mask and inhaled oxygen @ 5 L/min. After around 3 min, the symptoms subsided. The procedure continued for one more hour, and the anesthetist had to take supplemental oxygen twice intermittently. As he was wearing PPE and in the midst of a high-risk procedure, his arterial blood gas sample or vital readings were not taken. After the completion of the procedure, his routine blood examination, chest X-ray, 12-lead ECG, and 2D-echo were performed and found to be unremarkable. The anesthetist was otherwise healthy with no comorbidity but with a body mass index (BMI) of 29.32 kg/m². He had a high functional capacity due to cycling in hilly terrain for more than 2 h a day for around 5–6 days a week.

Discussion

With the pandemic expanding rapidly, the use of PPE in OT has become a very common practice amongst anesthetists, surgeons, and other OT staff as a precautionary measure. Subjective symptoms of restlessness and headache by health care workers while on PPE is not rare. Different studies done in the past tried to find out the various consequences of wearing PPE and N95 mask and the underlying causes. Fletcher *et al.* reported hypercapnia (EtCO₂ 47.25 mmHg) in an intensivist who developed dyspnea, tachycardia, and tremor while performing tracheostomy wearing PPE.^[3] Özdemir *et al.* found that wearing PPE by healthy, adult health care workers for 30 min in resting condition significantly increased end-tidal carbon-di-oxide (EtCO₂) and a fraction of inspired carbon-di-oxide (FiCO₂) without any subjective symptoms compared to pre-PPE values. However, heart rate, oxygen saturation (SpO₂), and the respiratory rate remained mostly unchanged.^[4] In OT while performing high-risk surgeries or anesthetic procedures, the stress and sympathetic overdrive, which is usually not quantified like other parameters may add to the symptoms of hypercapnia or turn asymptomatic borderline hypercapnia into a symptomatic one. Loibner *et al.* reported that heat stress and fluid loss increases with the increased temperature of working condition and varies with the type of PPE worn.^[5] However, in our case, the temperature of OT was around 22°C, and the anesthetist was neither thirsty nor dehydrated. Wearing an N95 mask alone for a longer duration may cause headache to the extent of requiring analgesics as reported by Lim *et al.* in their study.^[6] Rebmann *et al.* found that using an N95 mask with or without surgical mask overlay causes only an increase in the level of CO₂ from baseline without significant changes in other parameters that point towards decreased gas exchange like heart rate, SpO₂, and respiratory rate. Subjective symptoms were more common in those with high BMI and longer duration of use of a mask.^[7] An otherwise healthy anesthetist with good functional capacity developing such symptoms on PPE and N95 mask might be explained by high BMI, stressful working environment,

and higher levels of CO₂ due to the protective gear worn for a prolonged duration. Increased work of breathing and reduced tidal volume due to the tight-fitting mask might have a role as well because oxygen delivery @ 5L/min flow rate reduced the symptoms. Although the chances of desaturation in subjects wearing an N95 mask is debatable, there was a symptomatic improvement in our case following oxygen administration. It could also be because of the increased flow rate of the gas or better exhalation through the gap created by the oxygen tubing that was inserted into the mask.^[8,9] Development of such symptoms in the anesthetist or the operating surgeon at a critical step may lead to devastating complications. Further studies involving a large number of health care workers of varying BMI, with or without comorbidities, performing high-risk procedures and surgeries of varying duration wearing PPE should be conducted along with continuous monitoring of SpO₂, EtCO₂, vital parameters, and recording of subjective symptoms. This may help predict factors at high risk of development of discomfort amongst health care workers wearing PPE in an operating room.

PPE is yet the most reliable barrier for health care workers against COVID-19 infection if donning and doffing is done appropriately. Wearing PPE for a prolonged duration may have a significant physiological impact leading to subjective symptoms severe enough to compel the removal of mask or donning of PPE thereby compromising patient care and at the same time increasing the risk of contracting the infection. As COVID-19 pandemic is unlikely to end soon, such clinical scenarios are expected to be encountered more often. N 95 mask manufacturers should consider incorporating an oxygen extractor and a separate port for oxygenation to deal with such incidences in an OT.^[10]

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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