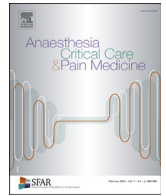




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Letter to the Editor

The feasibility of patients with coronavirus disease wearing N95 respirators during induction of anaesthesia


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To the Editor,

Today, after the outbreak of new severe acute respiratory syndrome coronavirus (SARS-CoV-2) in Wuhan, China, the same severe situation has erupted in various regions of the world [1]. As front-line medical personnel fighting the virus, anaesthesiologists have undergone severe tests in handling emergency operations for suspected or confirmed cases of coronavirus disease (COVID-19).

According to current findings, cough is one of the major symptoms of COVID-19 and also a way of spreading the virus [2]. Patients infected with the new coronavirus present uncontrollable coughing fit at the onset of the disease. In addition, in some cases, anaesthesiologists may also encounter patients' cough caused by the administration of opioids during the induction of general anaesthesia. These all have increased the risk of anaesthesiologists being infected with the new coronavirus.

So far, N95 respirators have been proven to reduce the spread of the virus effectively [3]. If the N95 respirators can be worn by the patients with COVID-19 during the induction of anaesthesia, it will inevitably reduce the risk of infection by medical staff in the operating theatre. However, the N95 respirator covers the patient's mouth and nose, which may increase the difficulty of performing mask ventilation.

In order to study the effect of N95 respirators on ventilation, we carried out an experiment on the anaesthesia machine (Carestation 620, GE, Boston, MA, USA). In the control group, we used a breathing circuit to connect the self-test lung (MP02400, Dräger, Lubeck, SH, Germany). While in the N95 group, we placed a N95 respirator (9501 V, 3 M Corp., St. Paul, MN, USA) between the breathing circuit and the self-test lung (Fig. 1). The oxygen flow rate was set to 2 L/min, the breathing frequency was set to 12 times/min and the airway pressure was limited to 20 cmH₂O (gentle positive pressure ventilation [inspiratory pressure < 20 cmH₂O] in conjunction with cricoid pressure is recommended during rapid-sequence induction

of anaesthesia to prevent aspiration) [4]. Then volume control ventilation mode was adopted and we compared airway peak pressure (P_{peak}), airway mean pressure (P_{mean}) and exhaled tidal volume (VT_{exp}) of the two groups under different tidal volume settings (Fig. 2).

As shown in Fig. 2, wearing a N95 respirator increased airway resistance. As the airway pressure was limited, even if the tidal volume was adjusted, there was still little gas that can enter the patient's lungs. Due to the limitation of airway resistance, setting a high tidal volume may cause the increase of pressure in the breathing circuit and more gas will leak out. Therefore, when the patient wears a N95 respirator, perhaps mask ventilation mode of small tidal volume and high frequency will be more suitable.

Many studies have focused on the ventilation of people wearing N95 respirators. Although the N95 respirator filters out potentially infectious particles, it also increases the physical burden on the wearers during moderate work and the difficulty of ventilation for patients with lung diseases. Our experiments confirmed that when wearing a N95 respirator, the difficulty of performing mask ventilation would be greatly increased. In the experiment, we did not consider the resistance of the patient's upper airway, which will further increase the ventilation resistance. Previous studies have pointed out that the pressure during coughing is mainly related to the muscles of the mouth. Li et al. concluded that covering the mouth might interrupt the horizontal transmission of exhaled air and protect co-occupant from direct contact with coughed particles [5]. Therefore, covering the mouth may greatly reduce the spread of the virus during coughing. At present, to provide a safer protocol of emergency anaesthesia induction without excessively increasing the difficulty of ventilation for the patients, which are suspected or confirmed of coronavirus disease, maybe more researches should focus on whether wearing a N95 respirator and simultaneously exposing the nasal cavity can reduce the spread of virus particles.

Nowadays, many methods and facilities for promoting preoxygenation have been proposed to protect medical staff in the operating theatre from the infection of the new coronavirus. Mask ventilation can be performed directly through facial mask without gas lacking by a physician who is well protected. The patient could wear a surgical mask instead of a N95 respirator to avoid aerosolisation and excessive ventilation resistance, while other scholars have proposed the method of preoxygenation with the patient's head into an intubation-box. During the fight against COVID-19, it is believed that more and more good methods will emerge. Simultaneously, perhaps the comparison between these methods deserves more studies and it is a feasible way to measure ventilation pressure and air lacking for comparison. In conclusion, we found that when wearing a N95 respirator for preoxygenation, the ventilation resistance will increase and the mask ventilation mode of small tidal volume and high frequency may be more suitable.



Fig. 1. Tight fitting N95 respirator connected in the breathing circuit.

Disclosure

Authors declare no conflicts of interest.

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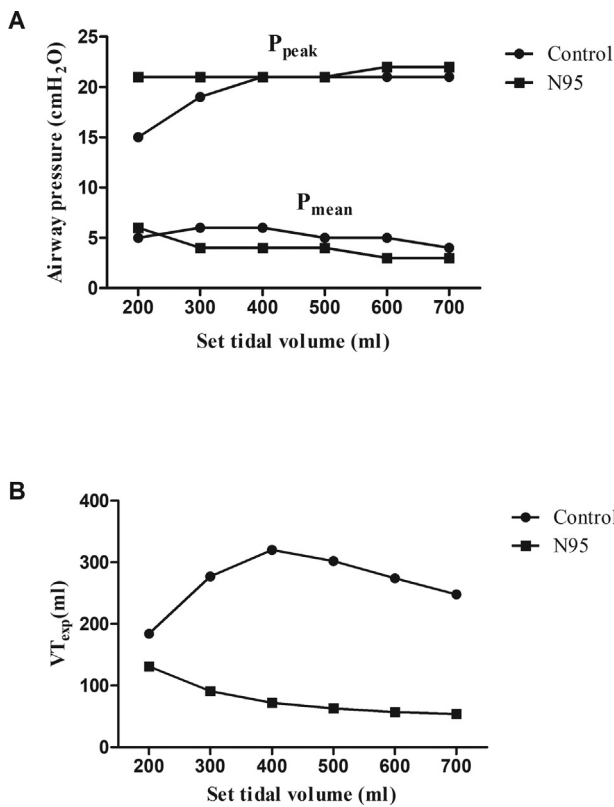


Fig. 2. Ventilation changes under different tidal volume settings. (A) Pressure-set tidal volume curves of P_{peak} and P_{mean} in control and N95 group. (B) Set and actual expiratory tidal volume curves in control and N95 group. P_{peak} = airway peak pressure; P_{mean} = airway mean pressure; VT_{exp} = expiratory tidal volume.