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EDITORIAL

The quest for meticulous patient care, even in the challenging COVID-19 era, is a trait inherited by professional anesthesiologists

Michiko Ushio[1] · Kanji Uchida[1]

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Respiratory complications such as hypoxemia and hypoventilation are likely to occur after general anesthesia [1]. The risk varies depending on surgical factors such as surgical insult, blood loss, and/or blood transfusion, as well as patient factors such as age, smoking history, and preoperative complications.

In particular, patients immediately after extubation are in a state of respiratory depression owing to residual drugs such as inhaled anesthetics, intravenous anesthetics, and muscle relaxants. For this reason, oxygen is often administered routinely, regardless of the patients' risk. Despite various controversies, reports that postoperative oxygen supplementation reduces postoperative infectious complications [2] have also encouraged the routine administration of oxygen.

Since the global pandemic of SARS-CoV-2 infection (COVID-19) emerged in early 2020, preventing transmission to healthcare workers and other patients inside the hospital has become an urgent and important issue. The patient's exhaled breath, which contains infectious viruses, can be spread into the room [3] especially during oxygen supplementation. Because surgical masks greatly reduce the spread of droplets and transmission of viruses [4, 5], it is recommended that even patients receiving oxygen after extubation wear a surgical mask [6, 7]. However, because the airflow through the surgical mask encounters more resistance than when not wearing a mask, the expected oxygen concentration may not be provided to the patient. It is very important, therefore, to prevent secondary infection caused by droplets from surgical patients after extubation while at the same time providing them with the expected concentration of oxygen.

Several reports have provided possible solutions to this problem. Binks et al. [8] reported no significant difference in fraction of inspired oxygen (F_IO_2) whether the oxygen mask was worn under or over the surgical mask. However, in another report, an oxygen mask over a surgical mask resulted in lower F_IO_2 than that under a surgical mask [9]. Matsui et al. [10] reported that the end-tidal oxygen concentration (EtO_2) was higher when oxygen was given via a nasal cannula under a surgical mask in comparison with administration via an oxygen mask over a surgical mask. Brown-Beresford et al. [11] reported that a surgical mask over a nasal cannula or oxygen mask was associated with higher EtO_2 compared with no surgical mask. All of these studies were based on a small number of patients ranging from one to five, and conflicting results make it difficult to accurately predict clinical outcomes.

The Journal of Anesthesia has just published two papers from a randomized, single-blinded crossover trial on the impact of surgical masks during oxygen supplementation [12, 13]. Matsui et al. [12] measured EtO_2 in 24 healthy volunteers with 4 L/min of oxygen in three different forms: an oxygen mask over or under a surgical mask and a nasal cannula under the surgical mask. A random crossover study revealed that EtO_2 was significantly higher in the order of a nasal cannula under the surgical mask, an oxygen mask under the surgical mask, and an oxygen mask over the surgical mask, with median values of 33.0, 31.0, and 25%, respectively.

Kinoshita et al. [13] investigated the effects of surgical masks during oxygen therapy using two different types of mask (closed and open type) in volunteers and a simulator. In the volunteer study, F_IO_2 was measured in 15 participants under two types of oxygen mask with or without a surgical mask. A surgical mask was worn only under an oxygen mask. They reported a significant decrease in F_IO_2 when volunteers wore surgical masks, and the decrease in F_IO_2 was greater with the open-type mask than with the closed-type mask. In the simulator study, although the magnitude

✉ Kanji Uchida
uchidak-ane@h.u-tokyo.ac.jp

1 Department of Anesthesiology, Graduate School of Medicine, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8655, Japan

of oxygen level differed from that of the volunteer study, patterns similar to those of the volunteer study were apparent; adding a surgical mask did not reduce F_IO_2 when the closed-type mask was used, whereas it significantly reduced F_IO_2 when the open-type mask was used.

In all studies, even when wearing a surgical mask during oxygen therapy, F_IO_2 or EtO_2 was elevated above ambient air, indicating that at least some oxygen was being administered. However, the actual oxygen levels were quite different in each case. It should be noted that with an oxygen mask over the surgical mask the oxygen concentration was 25%, more than 10% lower than the expected value [12]. The fact that the simulator neither consumes oxygen nor produces carbon dioxide and that the composition of exhaled and inhaled gases is the same is presumably the reason for the difference in the level of oxygen concentration between the results in the volunteer studies and those in the simulator.

In using low-flow oxygen delivery systems such as nasal cannulas and oxygen masks, rebreathing of exhaled gas and mixing of ambient air during inspiration have a significant impact on F_IO_2. In addition, non-woven surgical masks absorb moisture in exhaled air [14] and change permeability according to the moisture content. Those phenomena may impede oxygen administration.

When one precisely measures what usually has been conceived as a rough prediction in clinical practice, the results often differ from those expected. The authors of the two aforementioned papers [12, 13] carefully examined the actual value in clinical practice and produced high-quality data with great clinical relevance. Another group reported that there was no significant difference in pulse oximetry values between oxygen over a surgical mask and without a surgical mask after extubation in patients at low risk for postoperative hypoxemia [15]. It is conceivable that many postoperative patients recover without problems and that we may have overlooked the fact that their oxygen levels were different from those expected. However, in high-risk patients, unexpectedly low or high oxygen concentrations may affect the prognosis. The strength of professional anesthesiologists lies in achieving the best possible outcomes through meticulous management of fragile patients. Detailed examination of these two papers provides many suggestions.

We believe that a detailed perspective in daily clinical practice eventually leads to patient safety and further strengthens the identity of professional anesthesiologists.

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