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Brief Reports

A DUAL-USE LARYNGOSCOPE TO FACILITATE APNEIC OXYGENATION

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□ **Abstract—Background: In preoxygenated patients, time until oxygen saturation drops can be extended by insufflating oxygen into their airways, thus oxygenating them apneically. Objectives: To compare different methods of apneic oxygenation. Methods: A noncommercial dual-use laryngoscope with an internal lumen in its blade was used to provide oxygen insufflation into a simulated laryngeal space during intubation. In this experimental study, oxygen insufflation via the dual-use laryngoscope was compared with no oxygen insufflation, with nasal oxygen insufflation, and with direct intratracheal oxygen insufflation. In a preoxygenated test lung of a manikin, oxygen percentage decrease was measured over a 20-min observation period for each method of oxygen application. Results: Oxygen percentage in the test lung dropped from 97% to 37 ± 1% in the control group ($p < 0.001$ compared to all other groups) and to 68 ± 1% in the nasal insufflation group ($p < 0.001$ compared to all other groups). Oxygen percentage remained over 90% in both the direct intratracheal insufflation group (96 ± 0%) and the laryngoscope blade insufflation group (94 ± 1%) ($p < 0.01$ between the latter two groups). Conclusions: Simulating apneic oxygenation in a preoxygenated manikin, deep laryngeal oxygen insufflation via the dual-use laryngoscope kept oxygen percentage in the test lung above 90%, and was more effective than oxygen insufflation via nasal prongs.** © 2015 Elsevier Inc.

□ **Keywords—airway; apneic oxygenation; laryngoscope; insufflation**

INTRODUCTION

Preventing the patient from desaturation is crucial during emergency airway management, and preoxygenation is one essential tool, but it is less effective in critically ill patients (1,2). When a patient is not breathing, oxygenation of the patient's blood can be prolonged with apneic oxygenation, by insufflating oxygen into the patient's airway. Partial arterial oxygen pressure may thus be maintained at acceptable levels for more than 20 min (3). During apneic oxygenation of a patient with an unprotected airway, oxygen can be supplied either into the upper airway or transtracheally, which can result in serious injuries such as bleeding from thyroid vessels (4).

We developed a noncommercial suction laryngoscope blade with an internal lumen built into its blade to provide noninvasive oxygen insufflation into the laryngeal space during intubation efforts (Figure 1). This suction laryngoscope has been shown to be advantageous for inexperienced laryngoscopists when being faced with a very difficult airway due to simulated large amount of blood and vomitus (5). Although this feature is now well

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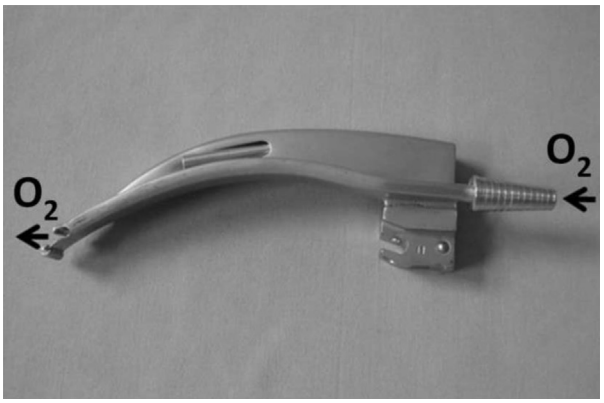

Figure 1. The dual-use laryngoscope blade, side view. Arrows indicate inflow and outflow of oxygen through the dual-use laryngoscope blade.

researched, it is unknown how effective apneic oxygenation via this laryngoscope blade (dual-use laryngoscope) compares to other strategies of oxygen insufflation. Therefore, we compared decreases in oxygen percentage for different strategies of oxygen insufflation in an experimental setting of apneic oxygenation in the preoxygenated test lung of a manikin. The null hypothesis was that there would be no difference in oxygen fraction decrease between groups.

MATERIAL AND METHODS

We attached the trachea of an anatomically correctly shaped male manikin, used for intubation training, to a test lung of 2.5 L volume, simulating the functional residual capacity of an adult man (Figure 2). Before each experiment, the test lung was preoxygenated to 97% oxygen content. Subsequently, we attached the test lung to an oximeter and used a suction rate of 200 mL/min (Julian, Draeger; Lübeck, Germany). Thus, we suctioned 200 mL/min of gas out of our test lung, which is a value comparable to oxygen consumption during apnea (6). In the control group, there was no oxygen insufflation. In the nasal oxygen group, we insufflated 15 L/min oxygen via nasal prongs. In the laryngoscope group, we insufflated 15 L/min oxygen via the dual-use laryngoscope (Figure 3). Finally, in the intratracheal oxygen group, we insufflated 15 L/min oxygen directly into the trachea via a long suction catheter. Insufflating via the upper airway, this catheter was positioned at the height of the cricoid cartilage, which is comparable to oxygen supply via transtracheal cannulation (we did not lacerate the manikin to avoid damaging it).

We performed seven experiments for each group, measuring the decrease in oxygen fraction for 20 min, after preoxygenation of the test lung to 97% oxygen content. Experiments were performed in random order. Measurements of oxygen fraction were performed by an observer blinded to the method of oxygen delivery. Data are reported as mean plus or minus ($\pm$) standard deviation. After Kolmogorov Smirnov analysis, a one-way analysis of variance for repeated measurements was performed to determine overall statistical significance between groups, with post hoc Tukey test for pairwise multiple comparisons (SPSS 15; Chicago, IL); $p < 0.05$ was considered significant.

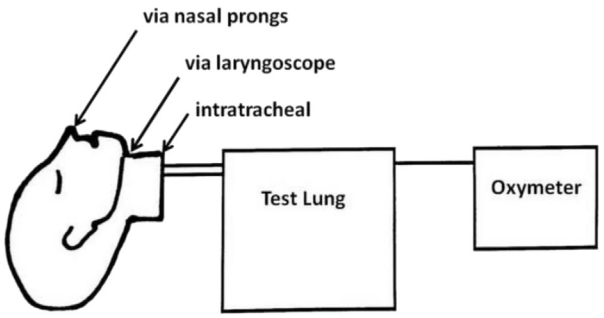

Figure 2. A manikin with an anatomically correctly shaped airway was attached to a test lung of 2.5 L. Nasal oxygen insufflation via nasal prongs, laryngeal oxygen insufflation via the laryngoscope, or direct intratracheal oxygen insufflation was applied.

RESULTS

During the 20-min observation period, oxygen percentage in the test lung dropped from 97% to 37 $\pm$ 1% in the control group ($p < 0.001$ compared to all other groups), and to 68 $\pm$ 1% in the nasal insufflation group ($p < 0.001$ compared to all other groups). Oxygen percentage remained above 90% in both, the direct intratracheal insufflation group (96 $\pm$ 0%) and the laryngoscope

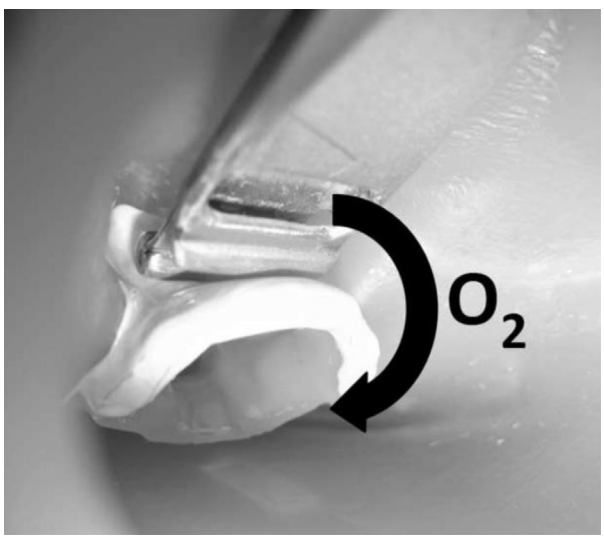

Figure 3. Position of the laryngoscope blade for intubation in a manikin airway model.