Noval Mandibular Advancement Bite Block Improve Oxygenation During Sedative Esophagogastroduodenoscopy

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Background and Goal

Drug-induced respiratory depression is a major cause of serious adverse events. Adequate oxygenation is very important during sedated esophagogastroduodenoscopy (EGD). Nasal breathing often shifts to oral breathing during open mouth EGD. A mandibular advancement (MA) bite block was developed for EGD using computer-assisted design and three-dimensional printing techniques (Figure 1). The mandible is advanced 6 mm when using this bite block to facilitate airway opening. The device is composed of an oxygen inlet with one opening directed towards the nostril and another opening directed towards the oral cavity. The aim of this study was to compare the inspired oxygen concentration (FiO₂) provided by nasal cannulas and MA bite blocks in sedated EGD.

Figure 1. Design and 3D printing of mandibular advancement bite block

Materials and Methods

For bench study, a manikin head was connected to a ventilator to mimic “patient” inspiratory effort. FiO₂ was evaluated continuously via the endotracheal tube connected to manikin under different oxygen flow rates, tidal volumes, and different mouth opening sizes (Figure 2). For clinical study, eligible patients undergoing sedative EGD were randomly assigned to standard bite block with nasal cannula and MA bite block groups. The primary endpoint was the oxygen saturation nadir. The secondary endpoints were upper airway obstruction and rescue event episodes.

Figure 2. Bench study setup

Results and Discussion

In bench study, the MA bite block provided higher FiO₂ under the same supplemental oxygen flow and the FiO₂ were as influenced by nasal or oral breathing compared to nasal cannulas. The measured FiO₂ using the MA bite block at oxygen flow of 5L/min was 62% during normoventilation. A low respiratory rate with a smaller tidal volume has a relative high FiO₂ (Figure 3). In clinical study, oxygen saturation nadir was significantly higher for MA bite blocks vs. the standard bite block (95.42 vs. 93.57%, p= 0.041) (Table 1), as well as a significant reduction in adverse events such as subclinical airway obstruction, severe airway obstruction, or airway rescue interventions (p= 0.007) (Table 2).

Figure 3. Mean inspired oxygen concentration, (A) as the oxygen flow increased, the mouth orifice was 7.7 mm, simulating partial nasal and partial oral breathing; (B) as the ratio of oral to nasal breathing changed from mouth closed to mouth open, oxygen was delivered at rate of 2 L/min.

Groups	N/C (n = 87)	MA (n = 43)	p
O ₂ Sat Nadir (%)	93.57 ± 5.387	95.42 ± 3.238	0.041
O ₂ Sat < 90% (n)	19	3	0.026

Table 1. Oxygen saturation

Groups	N/C (n = 87)	MA (n = 43)	p
Complete Obstruction (n)	31	6	0.007
Apnea (n)	33	16	0.547
Rescue intervention	16	1	0.010

Table 2. Adverse Events

Conclusions

The MA bite blocks deliver a higher FiO₂ during EGD. The orifice size of the mouth opening, supplemental oxygen flow, tidal volume, and respiratory rate influenced the FiO₂ provided. The MA bite block could decrease hypoxemia, prevent airway obstruction and decrease the need for rescue intervention during sedative EGD.