Noninvasive Ventilation with Oral Mask: Key Determinants and Clinical Evidence

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Abbreviations

ARF	Acute respiratory failure
EPAP	Expiratory positive airway pressure
IPPV	Intermittent positive-pressure ventilation
NIV	Noninvasive ventilation
PEEP	Positive end-expiratory pressure

3.1 Introduction

In 1953, Dr. John Affeldt was the first to use intermittent positive noninvasive ventilation (NIV) via mouthpiece. In 1968, the Bennett lip seal, which fixes the mouthpiece in the mouth for sleep and seals the lips to prevent air leakage out of the mouth, entered the American market [1]. NIV has a considerable impact on the

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treatment of acute respiratory failure (ARF). Proper interface selection is a major determinant in achieving successful NIV because they are associated with adverse events such as air leakage, claustrophobic reaction, facial erythema, acneiform eruptions, and skin or eye injuries [2].

Patients have reported mouthpiece NIV to be easy to use during daily activities such as eating and speaking [1]. However, the use of this technology is not common and it is utilized in only a few centers. Currently, there are no evidence-based guidelines for this application. A small, angled mouthpiece or straw-type mouthpiece with volume-controlled ventilators can be used in patients with neuromuscular disease. An intermittent positive-pressure ventilation (IPPV) technique was used in one study [3]. This study included 257 ventilator users. Mouth IPPV was performed using commercially available mouthpieces for support during daytime and a mouthpiece with lip seal or custom orthodontic interfaces for nocturnal ventilator support. Mouth IPPV alone or other noninvasive ventilatory supports were reviewed for these 257 patients. Mouth IPPV was used during nocturnal support by 163 individuals, 61 of whom had little or no measurable vital capacity or significant ventilator-free breathing time.

In terms of a patient's ability to use the mouthpiece, NIV can be more reliably performed via a Lipseal (Philips-Respironics Inc., Murrysville, PA, USA) or Oracle (Fisher & Paykel Healthcare Inc., Auckland, New Zealand) mouthpiece interface if sedation is required. This kind of oral interface is designed to reduce air leakage. Nose plugs may be required if nasal air leak occurs in the patient (Figs. 3.1 and 3.2).

One study reported that mouthpiece ventilation was used by patients undergoing bronchoscopy [4]. Physiologic parameters consisting of ventilatory parameters, indexes of patients' respiratory effort, gas exchange, leaks and asynchrony, and comfort were evaluated in another study. The study suggested that a mouthpiece is as effective as a full-face mask in reducing inspiratory effort in both hypoxemic ARF and hypercapnic ARF.

A leak is a significant complication during the mouthpiece ventilation. Levels of leaks were relatively moderate and were lower with the largest mask, being present in 36 % of cases with oronasal masks and 60 % with mouthpiece [5]. A mouthpiece is probably more appropriate for patients with chronic conditions than for patients in respiratory failure.

Mouthpiece ventilation increased pH and lowered $paCO_2$ and prevented endotracheal intubation requirements in patients with respiratory failure due to chronic obstructive respiratory diseases and cardiac insufficiency. Mouthpiece ventilation has also been recommended for the treatment of severe sleep-related breathing disorders [1]. A lip seal or custom orthodontic interface has been used for nocturnal mouthpiece noninvasive positive pressure ventilation.

Fig. 3.1 Oracle Fisher oral mask

Fig. 3.2 Mouthpiece ventilation. Respironics Mouthpiece Ventilation (MPV) Support System

3.2 Discussion

The most significant benefits of a mouthpiece to support ventilation are less interference with speech, little dead space, better appearance, no necessity of headgear, and, therefore, no possibility of claustrophobia.

The greatest disadvantage is that it is useful predominantly during the daytime except when retained by a lip-covering interface such as Lipseal or Oracle at night [2, 3]. Another disadvantage limiting its use in ARF is nasal leakage, however, mouth air leaks can be controlled with a tight-fitting lip seal and nasal plugs or nose clips can be used to prevent air leak via the nares [3, 6].

Vomit aspiration is a potential complication. In addition, air may be swallowed and cause gastric distention. The advantages and disadvantages of mouthpiece use are summarized in Table 3.1.

Table 3.1 Advantages and disadvantages of mouthpiece use

	Advantages	Disadvantages
Mouthpiece	Lower interference with speech Very little dead space No requirement for headgear Eliminates any possibility of claustrophobia Better appearance	Less effective if patient cannot maintain mouth seal Usually requires nasal or oronasal interface at night Nasal air leakage Mouthpieces can cause gag reflex, salivation, or vomiting Long-term use can cause orthodontic deformities

Mouthpiece ventilation can be obtained with positive expiratory pressure (expiratory positive airway pressure (EPAP) or positive end-expiratory pressure (PEEP)) but it cannot be maintained for patients using open systems of NIV. Obstructive apneas are relieved by sufficient positive inspiratory pressure delivery. Apnea alarms, when present, should be set at the highest threshold to avoid unnecessary activation and nuisance.

The most common ventilator mode used is assist volume-controlled with tidal volume between 0.7 and 1.5 l with no PEEP (EPAP), low pressure alarm set at the minimum, and maximum apnea duration. Although volume cycling permits air stacking, when gastric inflation is severe, volume cycling is discontinued in favor of pressure cycling. A gastrostomy is needed in some patients so that air insufflated into the stomach can be "burped out" during sleep. Mouthpiece NIV is not successful when patients are uncooperative, cannot access the interface, or when a severe bulbar dysfunction causes aspiration of saliva such that the O_2 saturation baseline remains below 95 %. It can cause or exacerbate dry mouth. Heated humidification or switching to oronasal interfaces may beneficial in such patients. Mouthpiece NIV can reduce risk of pneumonias and other respiratory complications. Its use improves cough, speech, and pulmonary compliance. These improvements can obtain high life quality for patients with neuromuscular diseases.

Conclusion

In conclusion, oral masks can delay invasive ventilation and improve the life quality for patients with neuromuscular diseases, sleep apnea, and chronic respiratory failure. The limitation is necessity of high cooperation ability.

Recommendations

- An oral mask can be the first choice for the patient requiring NIV.
- The mask can be helpful for the patient who has a claustrophobia.
- Further study should be recommended to spread use of oral masks.

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