

Editorial

How important is the Expiratory Resistance Level in the Expiratory Positive Airway Pressure (EPAP) Mask?

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Abstract

EPAP masks have been found to be effective in patients with snoring and obstructive sleep apnea and are FDA cleared for such purpose. EPAP masks are not always effective, but the reason for lack of effectiveness in some patients is not well understood. EPAP masks offer different levels of expiratory resistance, but it is not clear if such difference in expiratory resistance makes one mask more effective than another mask. Intuitively it is reasonable to think that more expiratory resistance would provide more pressure and therefore maybe more effective. That may not be so. We offer evidence that shows why expiratory resistance may not be an important factor that determines the effectiveness of the mask. Regardless of how much expiratory resistance, all EPAP masks work comparable to a low level of CPAP therapy and are more suitable for use in patients with snoring and mild to moderate obstructive sleep apnea. Having more expiratory resistance does not necessarily mean a more effective mask. A user should not worry too much about how much resistance a mask has and focus more on how comfortable is the mask and if they get better and quieter sleep.

ABBREVIATIONS

OSA: Obstructive Sleep Apnea; CPAP: Continuous Positive Airway Pressure; EPAP: Expiratory Positive Airway Pressure

INTRODUCTION

It is commonly believed that the application of Continuous Positive Airway Pressure (CPAP) is the gold standard for the treatment of obstructive sleep apnea. There is no doubt that this belief holds true when the CPAP machine is used as required. What happens when patients are not compliant, or abandon using the machine, or refuse to start on a CPAP machine? What are the options that a healthcare provider can offer the patient instead of the CPAP? Furthermore some patients snore or suspect of having obstructive sleep apnea but refuse to see a doctor for treatment. Indeed, in a recent editorial (1, Editorial) the authors argued that adherence to CPAP use should be considered when CPAP therapy is compared to other therapies. It was suggested that CPAP may be no better than other options that are available if one considers the noncompliance of patients [1]. Depending on the reason patients become non-compliant or refuse to use a CPAP machine, an EPAP mask may be an ideal option to offer such patients. The EPAP mask provides more convenience because it does not require a power supply and is easily portable, making it

ideal for use during travel, camping or during a flight and is worth consideration as an option for patients. EPAP technology has been FDA cleared for the treatment of snoring and obstructive sleep apnea, and therefore it is important to develop a better understanding of the pros and cons of EPAP masks.

The EPAP mask employs a 2-way valve, allowing the patient to inhale easily through a low-resistance path, but during exhalation, air flow is restricted by a high-resistance path, causing the pressure in the upper airway to increase, preventing upper airway collapse. The EPAP mask or device is not equally effective in all patients [2], but the exact reason is not very clear. One study tried unsuccessfully to identify which patients are most likely to benefit from using the EPAP device [3]. Arguably, one factor is thought to be the level of expiratory resistance. It is thought that a higher expiratory resistance may produce more pressure during expiration and may become more effective for the therapy of sleep disordered breathing. Some EPAP devices have a fixed resistance of different magnitudes such as Provent, (discontinued), Bongo Rx [4] or ULTEpap masks [5], while others such as Optipillows EPAP mask, has a variable resistance [6]. It is not clear if such a difference in resistance makes one mask better than the next mask because of how much pressure they generate during expiration. Studies with one EPAP device (Provent), have shown a wide range in the pressure (4 to 17 cm H₂O) generated

during expiration [7]. If the pressure is important, then one would predict that the EPAP device may be more effective in patients having a higher expiratory pressure. Yet there is no data to support such notion. These data may be interpreted as evidence that the expiratory resistance and pressure may not be very crucial for the effectiveness of the EPAP mask. Indeed, one study compared the effectiveness of EPAP devices (Provent) having different levels of resistance, and showed that different levels of expiratory resistance do not impact the effectiveness of the EPAP device [8] supporting the notion that level of the pressure during expiration may not be very critical.

EPAP masks have different levels of expiratory resistance, however, the level of the resistance may not be very crucial, but must be sufficient to cause expansion of the upper airway during expiration. Upper airway obstruction is an event that occurs during inhalation when a small negative pressure is generated in the upper airway, causing suction within the upper airway and a tendency to collapse the upper airway. Normally, obstruction does not occur in healthy individuals because the wall of the upper airway is "healthy" and is not easily collapsible. However, in patients with Obstructive Sleep Apnea (OSA), the upper airway becomes more susceptible to collapse. Increased collapsibility of the upper airway can be due to various factors including loss of muscle tone, fat deposits around the upper airway wall, neural activity, radial traction and lung volume [9]. Regardless of the resistance of the EPAP device, what matters more is the state of collapsibility of the upper airway at end expiration (just preceding inhalation). There is evidence that with EPAP, the upper airway tends to remain slightly expanded at end expiration [7], but no data to show if the size of the upper airway at end expiration correlates to the pressure level during expiration. It is likely that once the pressure returns to zero at end expiration, the state of collapsibility of the upper airway will determine if obstruction is likely to occur during inhalation. This explains the lack of significant difference when using EPAP devices with different resistance levels [8] and also explains why in some patients, the EPAP device may not be very effective [2]. CPAP provides a steady pneumatic stent, that maintains the upper airway expanded throughout the entire breathing cycle [10], preventing the likelihood of airway collapse. In contrast, with EPAP the upper airway fluctuates in size, being more expanded during expiration when the pressure is elevated, to being less expanded at the end of expiration when the pressure returns to atmospheric level. What is important is the size of the upper airway at end expiration which tends to be slightly expanded [7].

It is possible to say that EPAP therapy (regardless of the expiratory resistance), is comparable to CPAP therapy with a low pressure range. EPAP is effective in patients with mild to moderate obstructive sleep apnea, but less effective in patients with severe OSA [2]. The same can be said about low CPAP level. The EPAP simply provides a gentle stent at end expiration, keeping the upper airway a little more resistant to collapse and yet collapse is possible if the upper airway is not very "healthy". The level of expiratory resistance in the EPAP mask may not be important for the effectiveness of the mask for preventing upper airway collapse, but maybe more relevant to comfort

of the patient and may be important to compensate for leaks around the nasal pillows. For example, an EPAP mask with high resistance, can tolerate some air leak around the nasal pillows, without compromising the effectiveness of the EPAP mask and the therapy.

CONCLUSION

In conclusion, EPAP mask is worth considering as an option for patients who need therapy for snoring and obstructive sleep apnea but refuse to consider a CPAP machine and for patients who decide to stop using their CPAP machine. The EPAP mask can be used as added option besides the CPAP machine or when it is inconvenient to carry or use a CPAP machine such as during travel or camping. The EPAP mask, regardless of the level of expiratory resistance, is comparable to CPAP therapy with low pressure range and is more appropriate for people with snoring and mild to moderate obstructive sleep apnea but not for people with severe obstructive sleep apnea.

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