PAPnip: An “Alarming” Source of Leak during ASV Therapy

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A 37 year-old man with a BMI of 38 kg/m² was evaluated for excessive daytime sleepiness, loud snoring, and witnessed pauses in breathing. Epworth Sleepiness Scale score was 12. Physical examination demonstrated a Friedman palate position of 4 and a neck circumference of 45.5 cm.

Polysomnography showed severe obstructive sleep apnea (OSA) with an apnea-hypopnea index (AHI) of 90 per hour. During continuous positive airway pressure (CPAP) titration, he developed frequent treatment-emergent central apneas and was diagnosed with complex sleep apnea. His respiratory events were completely eliminated with an adaptive servoventilation (ASV) device set at an expiratory positive airway pressure of 10 cm water pressure. He was prescribed an ASV device and asked to follow up in 1 month.

On a follow-up visit one month later, he reported persistent and disturbing low-pressure machine alarms throughout the night. He reported insufficient pressures during the night. Epworth score was 10. Device download indicated an average leak of 80 liters per minute. During office troubleshooting, mask fit was excellent; there were no apparent leaks in the ASV device hose or in the pressure generator

connections. A close look at the tubing is shown in **Figure 1**.

Figure 1—Pressure-sensing tube of ASV device

QUESTION:

What do you see in Figure 1? What is the cause of his persistent low-pressure alarms?

ANSWER:

Lacerations in the pressure sensor tube lead to significant leak and repeated low-pressure alarms. The subtle punctures in the pressure sensor tubing were not seen until the tubing was closely inspected and folded (Figure 2), revealing the large lacerations causing leak.

DISCUSSION

Unintentional air leak during PAP usage can result from seal leak, mouth leak, or a defect in the device. Unintentional air leak leads to sleep disruption, airway drying, and ineffective therapy by pressure loss. Many PAP devices provide an audible “Leak Alert” function. A professional mask fitting with the PAP machine running to ensure proper fit is crucial. Mask and head gear fit should minimize leak while maximizing comfort. Additionally, with use and washing, strap length and elasticity change, requiring periodic readjustment. Leakage can occur at rubber tubing cuffs if not fit smoothly. Mouth leak can be minimized by chin straps or full face masks. A device defect is deleterious and should be assessed by inspection, listening, and feeling for extraneous airflow. Although PAP usage can be reliably determined from PAP device tracking systems, the leak data are not as easy to interpret as PAP usage since the definitions of these parameters differ among PAP manufacturers.¹ Nonetheless, ends of the spectrum (very high or low values for mask leak) appear to be clinically meaningful.

In our case, careful inspection of pressure sensor tubing showed subtle lacerations only evident after folding the tubing (Figure 2). Further history revealed that pet cats slept with the patient and were noted to rambunctiously play with his tubing. After recognizing this apparent case of “PAPnip,” the patient was advised to keep his cats away from his PAP device. Device download following tubing replacement showed resolution of leak. Even on simpler PAP devices, excessive leak may be associated with impaired adherence and nasal discomfort.² During follow-up, all patients should be asked to bring their PAP device and should be questioned about operation of their equipment. They should also be questioned regarding their device cleaning practices, and frequency of replacing the masks and filters. In addition to review of the device download, clinicians should check mask and head gear fit, adjustment, and seal with the patient’s device running to evaluate whether there may be mask or head gear adjustment problems or substantial leak under active pressure. Early follow-up after initial PAP introduction may lead to more successful outcomes and better adherence in patients with sleep-disordered breathing.³

SLEEP MEDICINE PEARLS

1. This case illustrates why it is essential for the patient to bring all of their equipment (and not just their data card) to follow-up visits, so that troubleshooting may be thorough, effective, and efficient.
2. Careful assessment of a patient’s interface, tubing, and pressure generator is necessary to successfully troubleshoot leak that may impact PAP adherence.

Figure 2—Careful inspection of the pressure sensor tube showed lacerations only evident after folding the tubing

3. Mask fit may be better evaluated in office by asking a patient to wear his/her mask with the PAP device running. Until a mask is under pressure, it is difficult to evaluate the fit adequately.

ABBREVIATIONS

AHI, apnea-hypopnea index
ASV, adaptive servoventilation
CPAP, continuous positive airway pressure
OSA, obstructive sleep apnea
PAP, positive airway pressure

CITATION

Jinnur P, Morgenthaler TI, Gay PC. PAPnip: An “alarming” source of leak during ASV therapy. *J Clin Sleep Med* 2014;10(7):819-821.

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SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication March, 2014

Submitted in final revised form May, 2014

Accepted for publication May, 2014

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DISCLOSURE STATEMENT

This was not an industry supported study. Dr. St. Louis has received research support from the Mayo Clinic Center for Translational Science Activities (CTSA), supported by the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant Number 1 UL1 RR024150-01. The other authors have indicated no financial conflicts of interest.