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SLEEP MEDICINE PEARLS

Sudden Improvement in PAP Download Indices Without Treatment Change

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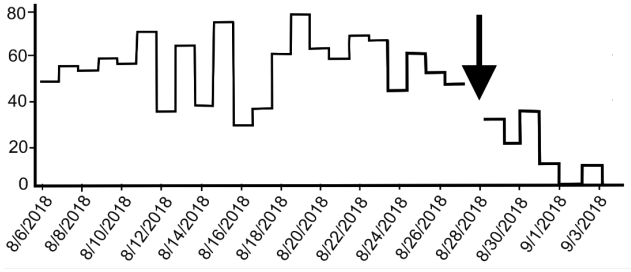
A 77-year-old woman with a history of atrial fibrillation (AF) and congestive heart failure with a left ventricular ejection fraction (LVEF) of 20% and moderate obstructive sleep apnea (OSA) presented to the sleep clinic. She was being treated with auto-adjusting positive airway pressure (APAP) using a pressure range of 6 to 12 cmH_2O for an apnea-hypopnea index (AHI) of 18 events/h with 4 central apneas. During an initial sleep clinic visit a large amount of periodic breathing was noted on the APAP download and the 90% pressure was 10 cmH_2O. The pressure range was narrowed to 6 to 10 cmH_2O. A PAP titration was considered but delayed as the patient was scheduled for an ablation procedure for treatment of AF. The procedure performed on July 27, 2018 did not restore sinus rhythm. After a cardiology visit, a subsequent procedure was planned. At her next visit, APAP device information showed an interesting pattern (**Figure 1**). A summary of 2 nights using the same treatment pressure and mask are shown in **Table 1**.

QUESTION: What resulted in the dramatic reduction in periodic breathing (Figure 1) and improved effectiveness of APAP (Table 1)?

Figure 1—Portion of the PAP download showing the percentage of night in periodic breathing.



Average percentage of night in periodic breathing was 44.7%. Note abrupt change at the arrow. PAP = positive airway pressure.

Table 1—Respiratory event summary.

Night	8/26/2018	9/3/2018
Apnea-hypopnea index (events/h)	25.4	4.0
Clear airway apnea index (events/h)	9.3	0.4
Obstructive airway apnea index (events/h)	6.5	1.3
Hypopnea index (events/h)	9.6	2.3
Periodic breathing (%)	53.6	0.0
Pressure range	6–10	6–10
90% pressure	10.0	9.5

All indices are number of events/h of monitoring time. Classification of event type by positive airway pressure device algorithm.[1]

ANSWER: The patient underwent successful cardioversion, restoring sinus rhythm on August 27, 2018.

DISCUSSION

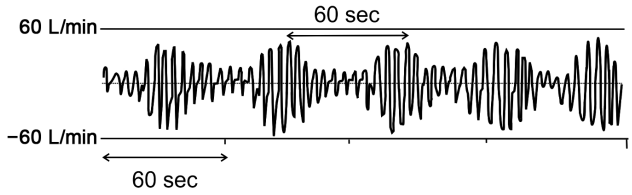
As a marked change in effectiveness of APAP was noted over the past week, the patient was questioned about any changes in cardiac medications or treatment. She reported cardioversion on August 27, 2018 that restored sinus rhythm. APAP was not used the night of her procedure. Prior to cardioversion, the AHI was elevated with a significant fraction of the events being classified as "clear airway apneas"[1] (**Table 1**). A 1-night detailed waveform report (PAP device flow) demonstrated elevated periodic breathing (**Figure 2**). The waveform shows a Cheyne-Stokes pattern with hypopneas at the nadirs in airflow and a cycle length of approximately 60 seconds.

The machine information following cardioversion showed a dramatic decrease in periodic breathing (**Figure 1**). The patient reported that she slept better and felt more rested after the cardioversion. The AHI also gradually improved (**Table 1**). Postcardioversion echocardiography within 4 weeks of the procedure showed a significant improvement in her LVEF to 45%.

A significant number of patients with AF and heart failure have both OSA and central sleep apnea (CSA), often of the Cheyne-Stokes type. The relative proportion of OSA and CSA in an individual patient can vary over time depending on cardiac function and fluid status.[2–4] This case highlights the clinical observation that a change in cardiac function can dramatically affect the success of PAP treatment. A study of 116 patients by Fox et al. showed that cardioversion and restoration of sinus rhythm were associated with decrease in central respiratory events with a significant (although small) reduction in AHI.[5] Another study by Naruse and coworkers showed a decrease in AHI after restoring sinus rhythm after catheter ablation.[6] In that study the patients had primarily obstructive apnea. A recently published case report[7] described a patient with a normal LVEF and atrial flutter in whom periodic breathing decreased sharply on a PAP download for 5 days following the procedure. Periodic breathing sharply increased during the sixth night with return to atrial flutter. Although, our patient had a reduced LVEF, individuals with AF and a normal LVEF can also have central apnea and periodic breathing. In a study of patients hospitalized with AF and normal LVEF, the percentages of patients with an AHI $\geq$ 15 events/h and predominant obstructive, central, and mixed events were 15%, 10%, and 36%, respectively.[7] Patients with both central and mixed predominant events had a significant amount of Cheyne-Stokes breathing. Our patient had improvement in LVEF following cardioversion and this likely was caused by restoration of the "atrial kick" because no medications were changed.[8] Of note, the events classified by the PAP device as obstructive airway apneas[1] also improved in our patient. One possible explanation is that some of these events were closed airway central apneas.[1] Some devices may differ in response to central apneas.[9] Another explanation is that nocturnal rostral fluid shift to the upper airway was minimized with improved cardiac function, reducing upper airway obstruction. Studies have suggested that rostral fluid shift can increase central and obstructive apneas.[4] Our patient did not have significant pedal edema but some fluid shift during the night was still possible. Two other possibilities that could explain the changes noted in our case include mask leak and body position. In this case mask leak did not change based on download and the patient reported sleeping in the lateral position.

Certain PAP devices now provide detailed waveform information that can assist in understanding a high residual AHI or periodic breathing. Our patient review of the detailed waveform, available from a night when periodic breathing was increased, showed a Cheyne-Stokes pattern. Other device downloads provide an estimate of the amount of Cheyne-Stokes breathing. Our patient and the recent case report suggest that close monitoring of PAP download information is potentially useful in detecting a change in status of patients being treated for atrial fibrillation/flutter. Prospective evaluations in a large group of patients are needed to substantiate this hypothesis.

Figure 2—An illustration of a fragment of the detailed waveform report showing flow over a 4-minute period labeled as periodic breathing.



The flow shows a pattern of Cheyne-Stokes breathing with hypopneas at the nadir and a cycle time of 60 seconds.

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1. Changes in the treatment status of atrial arrhythmias can dramatically alter the effectiveness of PAP treatment.
2. Reviewing the data from the PAP device in patients with respect to the amount of periodic breathing is potentially useful in patients with current or prior treatment for AF or congestive heart failure.
3. Understanding of the results of PAP device download in patients with cardiac disorders is enhanced by knowledge of treatment changes or documented changes in cardiac rhythm and function.

CITATION

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