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Case Report

Diagnostic and Treatment Approach of Complex Sleep Apnea Syndrome (ComSAS) Case Presenting with History of Snoring, Daytime Sleepiness, and Falling Asleep at Traffic Light

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Abstract

Prevalence of complex sleep apnea syndrome (ComSAS) is growing after its true characterization and clinical presentation, which enhances an appropriate diagnostic approach for its better treatment and outcome. Complex sleep apnea is a form of sleep-disordered breathing in which patients have respiratory control dysfunction and upper airway obstruction; it often clinically presents as central sleep apnea (CSA) and is mostly seen in obstructive sleep apnea (OSA) patients during the initial phase of continuous positive airway pressure (CPAP) treatment. Polysomnographic testing is a diagnostic tool required for its confirmation and the pathophysiology is characterized by the central apnea index (CAI) being five or more events/hour or the presence of disruptive Cheyne-Stokes breathing pattern. The development of complex sleep apnea involves breathing pauses, upper airway changes, variability of PaCO2 levels and an oscillating sleep state. ComSAS mainly happens in unstable sleep conditions but not necessarily always. It's clinical presentation is difficult to distinguish from CSA and OSA because of the pattern of apneas and hypopneas where most hypopneas are obstructive with strong periodic breathing resemblance of an oscillatory pattern. Here, we are discussing a case report of ComSAS patient with no obvious risk factors receiving CPAP therapy [1-3].

Keywords: *Complex Sleep Apnea Syndrome (ComSAS); Central Sleep Apnea (CSA); Obstructive Sleep Apnea (OSA); Continuous Positive Airway Pressure (CPAP); Central Apnea Index (CAI)*

Background

The identification of sleep apnea syndrome is a serious public health problem. The diagnosis is often critical because of its similar presentation to OSA. Its been noted for an extended period of time that patients present with OSA at baseline with accompanying CSA events after continuous positive airway pressure (CPAP) application. This breathing disorder was initially defined as "treatment-emergent central apnea". Later, the term "complex sleep-disordered breathing" was introduced by Gilmartin., *et al*. to define this phenomenon, and then Morgenthaler., *et al*. called it "complex sleep apnea syndrome-ComSAS". This title, "ComSAS" has gained more popularity and is now a widely known term [4].

Initially, some researchers didn't even consider CompSAS a disease but just a set of varying etiological entities, mostly self-limiting. Its definition is also varied in the literature in most cases. It initially manifests as an obstructive component, but the presentation of a predominant Cheyne-Stokes or frequent central apneas pattern categorizes this as CompSAS. The Sleep Medicine community resolved all these concerns and established its literature by defining its definition, potential mechanism, clinical features, and treatment approach [5].

Case Presentation

A 51 year old pleasant and cooperative male patient weighing 101.1 kg in the process of losing weight with a height of 175.2 cm and a BMI of 32.9 kg/m^2 presented with snoring, day time sleepiness and history of falling asleep at traffic light. He was well-nourished with no acute distress and no retrognathia; his pupils react bilaterally, and he had no conjunctival injection as well as no nasal septal deviation. No injection was noted in the nares. The turbinates were without hypertrophy and the patient had no complaints of rhinitis. His pharynx showed a modified Mallampati Class I airway. Neurologically, he was alert and oriented to person, place and time.

He was investigated for a sleep-related breathing disorder based on the complaints indicated by a polysomnogram - all night. His ESS score was 10/24 (normal < 10). A home sleep study showed apnea-hypopnea index (AHI) of 54.9/hour with some central as well as obstructive and mixed apneas and obstructive hypopneas. Patient ordered an in-lab titration study to determine the most effective therapy for complex sleep apnea. An in-lab sleep study was requested, and CPAP was administered, which was followed by bilevel PAP therapy. A diagnosis of ComSAS was made based on the polysomnography results.

Investigations

Polysomnography

The study was performed with a sleep technologist in attendance during the entire test period. Video monitoring was carried out throughout the study. The overnight sleep test recorded the nasal pressure, pulse oximetry (oxygen saturation and heart rate), rib cage, abdominal movement, and the body position airflow by nasal cannula. The sleep period lasted 352.5 minutes and the total sleep time (TST) was 283.0 minutes, which resulted in a sleep efficiency of 77.8%. The sleep latency (SL) was 11.1 minutes and the latency to the first occurrence of stage R was 188.0 minutes. There was 1 stage R period observed on the study night, 19 awakenings, transition to stage W from any sleep stage and 74 total stage transitions.

The patient experienced 28 apneas in total. 2 were identified as obstructive, 1 was mixed and 25 were central apnea, resulting in an apnea index (AI) of 5.9 apneas/hr. The hypopnea index (HI) was 11.9 hypopneas/hr as the patient experienced 56 hypopneas. The overall apnea-hypopnea index (AHI) during the PAP therapy was 17.8 events/hr, while the AHI during stage R sleep was 1.7/hr.

There were a total of 114 periodic limb movements (PLMS) during sleep, of which 25 were PLMS arousal. This resulted in a PLMS index of 24.2/hr and a PLMS arousal index of 5.3/hr. Analysis of electrocardiogram activity showed the highest cardiac rate during the recording was 75.0 beats per minute. The average heart rate during sleep was 55.3 bpm, while the highest heart rate for the same period was 70.0 bpm. No significant cardiac arrhythmias were seen.

Analysis of continuous oxygen saturations showed a mean oxygen saturation (SpO_2) value of 95.6% with a minimum SpO_2 during sleep was 85.0% and a mean value was 95.1% for the same period. Oxygen saturation was below 89% (=88%) for 2.3% of the time spent asleep. The patient experienced 106 arousals in total equating an arousal index of 22.5 arousal/hr. Out of all these, 29 were identified as respiratory-related arousals (6.1/hr), 25 were PLM related (5.3/hr) and 52 were spontaneous (11.0/hr), with no identifying cause.

CPAP was offered and then switched to bilevel due to persistent sleep-disordered breathing pauses. Bilevel at 15/10 CW with BUR 8 on room air was administered for 3 hours 7 minutes and resulted in a reduction of the Apnea-Hypopnea Index (AHI) to 2.8 events/hr with a SaO_2 minimum 90%. Recommended for bilevel at 15/10 CW and BUR 8, on RA, with medium air fit F10 FFM. Defer Periodic Limb Movements of Sleep (PLMS) treatment, until after treatment of sleep apnea at Sleep center. Further Polysomnography details are explained in table 1 and 2.

Recording Times (min)	
Analysis Time (min)	469.2
Estimated sleep efficiency	92
Percentage supine time (%)	48.3
Quality of Recording	
Overall signal quality (%)	99.2
Oximeter quality (%)	99.1
Flow quality (%)	100
Thoracic RIP quality	100
Abdominal RIP quality (%)	100
Heart Rate	
Mean heart rate (bpm)	62.4
Minimum heart rate (bpm)	186.0
Maximum heart rate (bpm)	35
Oxygen Saturation	
Oxygen desaturation index (ODI, events/hour)	55.8
Average oxygen desaturation drop (%)	7.2
Mean SpO_2 (%)	91.9
Minimum SpO_2 (%)	78.0
Percent time SpO_2 less than 90%	22
Percent time SpO_2 less than 88%	13
Percent time SpO_2 less than 80%	0

Table 1: *Status of different indices during polysomnography.*

Diagnostic	
Supine	37.1/hr
Left	4.0/hr
Right	N/A/hr
Prone	N/A/hr
Respiratory Events and Indices	
Apnea-hypopnea index (AHI, events/hour)	54.9
Apnea-hypopnea index in supine position (events/ hour)	62.3
Apnea-hypopnea index in non supine position (events/ hour)	48.1
Snor index	250.3
Number of obstructive apneas	94
Number of central apneas	165
Number of mixed apneas	76
Number of hypopneas	94

Table 2: *Polysomnography results.*

Scoring details

- Apnea 90% drop in a flow signal between 10 and 120 seconds.
- Hypopnea 30% drop in the flow signal between 10 and 20 seconds followed by 4% drop in saturation.
- AHI Number of apneas and hypopnea per hour for analysis time.
- ODI Number of oxygen desaturation per hour of analysis time.
- Snore index Percentage of time spent snoring versus the total time spent in bed.

Treatment

Continuous positive airway pressure (CPAP) therapy was advised as a 1st line treatment. It was introduced in 1981 and is now the most common treatment for sleep apnea. It consists of a face mask and needs to be worn by the user when he or she sleeps. It is attached by a tube to a small, quiet machine that blows air into the mask. This prevents snoring and keeps the throat passage open by providing constant and steady air so that breathing is not obstructed during sleep with almost no risk. This treatment improves sleep quality and the patient's daytime energy levels.

Patient was advised to follow the instructed recommendations for using mask and was told to contact the prosthetics department every 6 months for mask replacement and contact the sleep center in case of any problems. Medications were also prescribed for better outcome of patient, see table 3.

Recommended Medicines		
Medicine	**Intake**	**Recommendation**
Albuterol	Inhale 2 PUFFS by mouth every 4 hours	For wheezing and shortness of breath
CoLyte (PEG Electrolytes Solution)	1 Container by mouth	Follow Bowel Preparation
Fluticasone Propionate	Instill 2 sprays in each nostril at bed time	For nasal allergies
Mometasone Furoate	Inhale 1 PUFFS by mouth at bed time	For breathing/ lungs
Atorvastatin Calcium	Take 1 half tablet by mouth at bed time	For Cholesterol to prevent heart attack and stroke

Table 3: *Prescribed medicines.*

Outcome

Polysomnographic pattern established the ComSAS with mild periodic limb movement disorder.

Discussion and Conclusion

The present case illustrates how important it is to carefully monitor the Polysomnography Pattern and the patient's condition for true diagnosis of sleep apnea. True and timely characterization is a key step for further treatment, management and follow-up. Delayed identi-

fication also enhances the chances of delayed and ineffective treatment. The literature won't define the absolute pathogenesis of ComSAS, but there are several factors that influence its pathophysiology (See figure 1) [2].

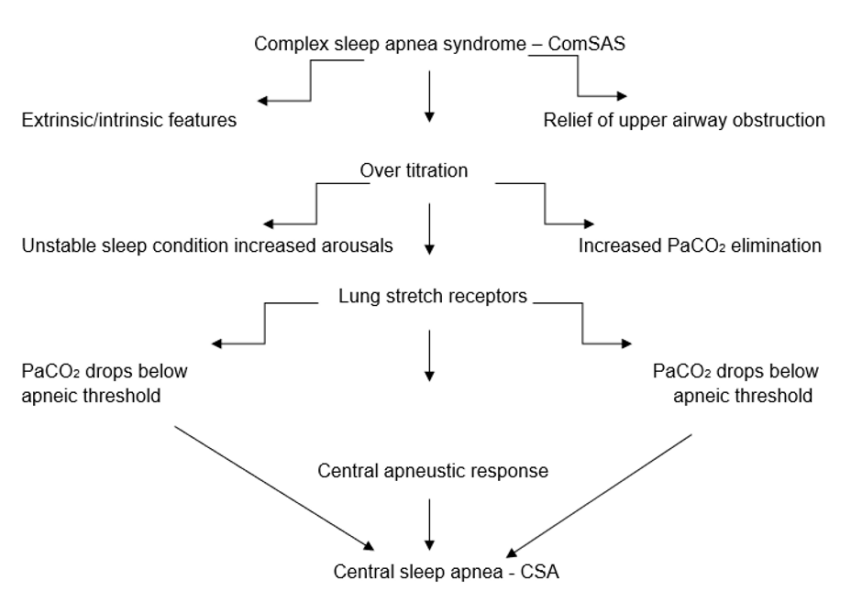

Figure 1: *Schematic representation of complex sleep apnea syndrome - ComSAS.*

ComSAS is more frequent in males as > 80% are affected versus 60% with OSA. This may be due to the increased hypercapnic ventilatory response. Its mechanism mainly involves raised chemoreceptor sensitivity, circulation time, dropping of arousal threshold and usage of opioid medicines [6]. During sleep, the arterial CO_2 ($PaCO_2$) level, oxygen (PaO_2) level and lung volume change, which leads to $PaCO_2$ variability. As a result, CPAP is required for its stabilization. This condition also enhances ischemic heart disease or heart failure incidence [2,7].

Some patients present with position-dependent ComSAS which is expressed in the supine position and by changing the patient to the lateral position, it resolves [1] but we did not find this phenomenon in our case. Several factors are also associated with ComSAS like Coronary artery disease, Congestive heart failure, Hypertension, Stroke, Atrial fibrillation, Diabetes mellitus, Chronic obstructive pulmonary disease, Asthma, Hypothyroidism, Depression, Neuromuscular weakness, Cognitive impairment, Parkinson's disease, End-stage renal disease, use of medications like Opioids and Benzodiazepines. The patient defined in this case had no recognized risk factor except that he was overweight with a BMI of 32.9 kg/m^2. It is, however, evident from all the reported studies and clinical practice that not all patients with CompSAS have any identified "risk factors" prior to the polysomnography (PSG) testing. Detailed research and comprehensive data needs to be explored further to define its pathogenicity and risk factors [8].

CPAP is a spontaneous and tried method for treating ComSAS. This syndrome usually settles after 1 - 2 months of regular CPAP therapy, and patient must be assessed after scheduled duration. The American Academy of Sleep Medicine (AASM) describes CPAP as a pressurized air generator that has a respiratory disturbance index (RDI) < 5 events/hr which should be kept for no less than 15 minutes with supine REM sleep. A large number of patients attain an RDI < 5 events/hr for 15 minutes but do not show REM supine sleep at the suggested

pressure [6]. The vast number of patients treated with CPAP report no complaints but caution is suggested for its usage and pressure settling [2]. In case CPAP shows no therapeutic effect, other treatment options are also available; for example, other options include adaptive servo-ventilation or Bilevel Positive Airway Pressure (BiPAP) treatment [9]. New and more efficient devices are also under development, promising a better future for sleep apnea patients by using increased CO_2 inhalation to stabilize breathing pauses [2].

In this case, the patient was informed of the results and, without any further examination, was advised to use a CPAP for the next 12 months. The patient was also scheduled for the follow-up appointment in the sleep clinic to assess the treatment response. PAP device was ordered based on the patient's study results. Despite the initial improvement of the sleep architecture and day symptoms, the patient's complaints re-occurred and a foreign body feeling increased.

Learning Points

- Complex sleep apnea syndrome (ComSAS) behaves differently compared to central sleep apnea (CSA) because of apneas and hypopnea pattern, which are mostly obstructive. Complex sleep apnea syndrome is a mixture of obstructive sleep apnea and hypopnea.
- To equate to Complex Sleep apnea syndrome, central apneas must require more than 50% of respiratory events.
- Majority of ComSAS cases resolve after continued CPAP therapy.
- Those patients who react poorly to CPAP therapy and exhibit therapy failures have other treatment options; these options include other progressive devices such as Bilevel Positive Airway Pressure (BiPAP) or adaptive servo-ventilation, which work effectively for treatment.
- Acetazolamide or the ophyllinemay are alternative medicines that are available when CPAP response is limited or poorly acceptable [3,5].

Patient's Perspective

The patient has been informed of the results and ordered in-lab titration due to his Complex sleep apnea syndrome - ComSAS. He will then be scheduled for a follow-up appointment in the sleep clinic to assess his response to treatment.

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