What's New With CPAP Technology?

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The latest advancements in CPAP technology have enabled patients with sleep disorders to rest easier and sleep more soundly.

Continuous positive airway pressure (CPAP) has undergone significant changes since being introduced to the public in 1981.[1] The machines developed decades ago were heavy, loud, and with limited capabilities when compared to the sleek, lightweight ones today. I have heard stories and seen photographs of machines being run by a motor with a fan belt covered by a box that looks similar to the old Singer sewing machine at my grandmother's house. The weight of a CPAP machine in the mid 1980s was between 15 and 20 pounds. How would you like to lug that monstrosity 3,000 miles across the country?

The most noticeable changes in today's CPAP equipment are the size, weight, and noise of the mechanical unit, but many other facets have improved dramatically. For example, a fisherman who spends numerous nights afloat in the Pacific Ocean during the cold winter has the ability to retire to his cabin, plug in his humidified CPAP unit with ambient tracking (thanks to a DC to AC inverter), and receive a good night's sleep. Or a mountain climber has set up base camp at an elevation of 8,000 feet prior to reaching the summit. He plugs his CPAP machine into an ambulatory power generator and does not have to worry about induced obstructive events as a result of the altitude because his autoPAP machine has an automatic altitude compensation feature so he too will receive a good night's sleep. CPAP, autoPAP, and bilevel PAP technology have advanced significantly in recent years

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Innovative Features

Whether CPAP manufacturers have copied aerodynamic technology from Lockheed-Martin or consulted NASA, the look of CPAP technology has come a long way and has changed dramatically. Weighing anywhere from 3.5 pounds and up, these mechanical devices are compressed with numerous features and innovative technology that have revolutionized patient and clinician interaction with CPAP. Most advanced CPAP and autoPAP machines contain microprocessors, which allow dense data storage, and internal self-testing to ensure hardware and software are functioning properly, and provide numerous reports that can detail specific parameters of patient usage. This allows clinicians to track patient compliance and obtain a record of usage through an hourly, daily, weekly, or monthly format. The key is obtaining the exact amount of usage on a daily basis. By recording mask-on-time rather than power-on-time (which the older CPAP models used by way of a digital meter), the accuracy of compliance measurement is outstanding. Some CPAP units have a smart feature to record the mask-on-time whenever a patient breathes into the mask and air delivery begins; and when the mask is removed and the air ceases. To bring this compilation of data to a higher level, the method used to extract the patient data has advanced remarkably. Now, certain manufacturers have developed a state-of-the-art means to efficiently and economically monitor patient information by way of the Internet. By placing a modem in a patient's home and hooking the monitoring device to a standard house phone jack, patient usage is automatically dialed to a server where the data is dumped and analyzed to measure compliance. If a patient has been noncompliant, this will be detected by the compliance server and an email notification will be sent to the clinician's office. This allows the physician to intervene sooner and increases the likelihood of a better outcome with long-term compliance.

Another remarkable characteristic about CPAP today is its low noise level. Aside from its size and weight, the ability of a CPAP unit to deliver filtered air to a patient at 20 cm H2O with only a very light humming is refreshing for clinicians as well as patients and bed partners. Due to lightweight blowers that are well insulated within the CPAP units, the days of sleeping next to a mechanically generated hurricane are gone. I spoke to a manufacturer who mentioned that a newer and quieter CPAP unit is in the works by utilizing a turbine blower and thick insulation, which will most likely alleviate any noise. How much quieter can you get? Soon, bed partners will complain that they cannot sleep because it is too quiet.

Whether a patient brings a CPAP unit into the physician's office or durable medical equipment (DME) company, downloads data via the Internet, or sends a data collection card through the mail, the updated versions of CPAP provide a simple means for improving compliance. To assist with adherence, one particular CPAP company has taken an extra step by creating a quiz that patients take on their machine. Specially developed questions are offered to the patients so they can

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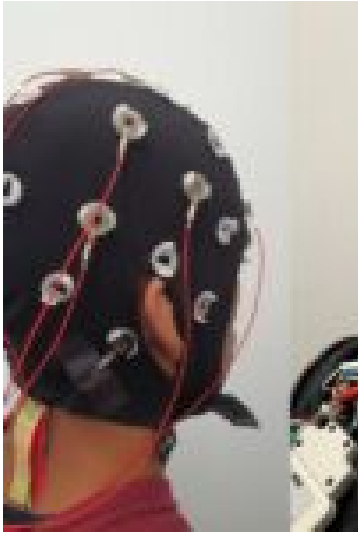

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phone calls regarding the clinician's protocol. Other features that most manufacturers appear to have implemented into their machines are LCD screens, duofilter systems, numerous ramp options, automatic altitude compensation, response to mask leakage and removal, inspiratory flow limitations, and the ability to store months of accruing data. Today, an autoPAP machine can record comprehensive data for diagnosis by providing specific features with abilities to measure oxygen saturation, apnea duration, heart rate, body position, dual-time meters (total machine usage vs cumulative patient compliance), and a snoring index. The capabilities of CPAP sometimes seem limitless.

Humidification

Water is a fundamental element of survival and for a high percentage of CPAP users with obstructive sleep apnea (OSA), it has become a necessity in the form of humidification. Recent studies have shown that patients given humidification, preferably heated, were more compliant with their CPAP therapy and symptoms were alleviated. Most symptoms of patients who use CPAP without heated humidity are dry nose and throat, burning, sinus infections, headaches, and nosebleeds. A group at Western Pennsylvania Hospital conducted a study in which it randomized OSA patients using CPAP to receive either heated humidification, cold passover, or no humidity. Nineteen patients in each part of the study were covertly monitored for CPAP use. By the study's conclusion, patients with heated humidification were more compliant with their CPAP therapy and experienced less drying of their airway passages. Patients with heated humidification complied with their CPAP therapy an average of 42 minutes longer per night.[1] The humidification designs have progressed so that it is interchangeable with CPAP. One manufacturer has specialized in heated humidification integrated with a CPAP/autoPAP machine as one unit. This lightweight and compact system is simple to use and makes it easy to travel. One customized feature about this humidified CPAP system is its ambient tracking to prevent condensation.

This is a relief for technicians as well as patients because it eliminates water condensation that builds in the hose and drips into the nasal/oral mask, causing a gurgling sound upon exhaled breathing. The ambient tracking automatically adjusts to the temperature of the room, which allows the sleep technician to set the heater plate at a higher temperature than a conventional humidifier without causing condensation. Other innovations utilizing heated humidification have also created an integrated or stacking compatible system. A handful of companies are using tubeless heated humidification units that plug directly into the CPAP
unit. Accessing controls for the humidifier are incorporated into the CPAP machine, allowing easy push-button control and display on an illuminated LCD screen atop the CPAP unit.

Accessories

Working as a nighttime polysomnographer, I can comfortably say that a specialty of our trade is fitting the patient with a nasal or oral mask.

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Meeting

When walking from booth to booth at the Associated Professional Sleep Societies (APSS) 16th Annual Meeting in Seattle this year, I was amazed at the number of masks that were on display. The nasal and oral CPAP appliances are plentiful, which provide technicians, clinicians, and patients more options of delivery, comfort, and style.

A couple of new innovative masks received a lot of attention. One used a newer method of delivery similar to that of an oxygen cannula. No headgear, pads, or straps were required to keep it from falling off the head. It does not touch any pressure points on the head and can be worn over the ears or down on the chest. Its tubing is thick enough so if a patient were to turn on his side, it would not kink or inhibit the flow of air. Another new product was an oral mask for the delivery of CPAP or bilevel therapy. The oral appliance is inserted into and seals around the mouth. The CPAP pressure pushes the soft palate to the top of the mouth, preventing any leakage out of the nose. The advantage of oral appliances appeared to be that they required no headgear or devices such as chin straps, offered the ability to use eyewear if the patient reads before falling asleep, and enabled the patient to breathe by way of the mouth by choice or as necessary; however, it is recommended that heated humidification be used in synchrony with the oral device due to symptoms of mucosal drying and congestion. Most of the manufacturers of nasal masks appeared to have fine-tuned or tweaked their already available features. One feature that has been prominently changed by most manufacturers is the material of the mask cushion. Most have stopped using latex since there was a higher probability of skin irritation, so they generally use silicone, which alleviates perspiration and irritation. One mask manufacturer uses a dual-thickness silicone cushion with an outer membrane that fills with air to create a comfortable seal while the inner section provides stability. It also comes equipped with a built-in silent exhalation valve, which disperses the exhalatory air pressure well so there is no “wind tunnel” or leakage sound. A couple of companies have revised the exhalation ports to cut down on excessive noise, which during the night can annoy patients and bed partners. At one of the booths, there was a rather new innovative mask that fits the underside of the nose, over the nares. The mask was small and unobtrusive, utilizing a soft, contoured gel cushion with headgear straps.

Even though you cannot always find a mask or have the perfect fit for every face, technological advances have progressed in the areas of patient comfort and convenience. Moveable forehead supports allow the mask to be adjusted to comply with different slopes and contours of the patient’s head and face.

Silicone cushions provide a good seal and come in three different sizes for comfort. One manufacturer has successfully introduced a way of delivering filtered air by using nasal pillows, which sit only on the nares.

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patients, or those who get skin irritations, appear to do very well with this sleep gear. Another mask combined both nasal and oral CPAP therapy by attaching a nasal mask to an oral appliance that acts as a structural splint to hold the jaw forward, preventing the tongue from collapsing into the airway. This method eliminates straps and securely holds the mask in a fixed position. The compliance of this duo-therapy is said to be good with low leakage and lower CPAP pressure.

Conclusion

Advances in technology and research have accelerated in the past couple of years, providing manufacturers, DME companies, sleep clinicians, and, most important, patients with CPAP machines that enable users to rest easier and sleep better in the future. Education and support inside and outside the clinical setting have grown, allowing better compliance for patients using CPAP. The ability to track patient progress has excelled and the boundaries are unlimited thanks to modems, microprocessors, integrated CPAP systems, and accessories. It has become a user-friendly dimension for all of us. It is a combination of comfort, technology, and progression.

So what fate lies before us and what further transformations will the field of sleep medicine undergo? See you next year at the APSS 17th Annual Meeting to be held in Chicago. I have a feeling that these questions are in the process of being answered.

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Reference

1. Kline LR, Carlson P. NCPAP acceptance and compliance is altered by humidification [abstract]. Sleep. 1999; 22(suppl):S230.

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