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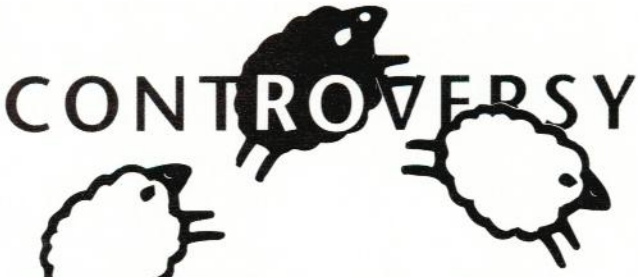

Surrounds HOME SLEEP STUDIES

BY TIM SCHLOSE, CRTT

I recently presented a lecture on diagnostic testing to a group of respiratory care practitioners from a respiratory home care company. The lecture involved primarily apnea. During a break, someone asked what I might do if I was awakened during the early hours of the morning with a problem involving a multi-channel sleep study. Dumbfounded, I replied, "Did the attending technician get sick, or die, or something?" The inquirer replied, "What do you mean attending technician?"

Soon we were deep into the controversy over attended or unattended multi-channel sleep studies. He explained that his company's policy was to perform "unattended" multi-channel sleep studies. The problems they were having were the same problems that have always caused me to feel strongly about the need for attended multi-channel sleep studies. Why is there all this controversy, and what is it all about?

In the beginning, pediatric sleep research was comprised of simple two-channel studies measuring chest wall impedance for respiration and V_2 lead ECG. This kind of study, known as a pneumocardiogram, reported a heart rate trend that allowed the complex waveforms to be reviewed during a pathological event. This information was either recorded analogically on paper or on magnetic tape. The first controversy occurred in regard to the length of recording or study time. Pediatric sleep researchers debated whether it was better to do the pneumocardiogram over a 12- or 24-hour period. When the polysomnography community settled on the 12-hour test as the standard length, hospitals and home care companies fell in line with its decision.

The next question to consider was whether the pneumogram reveals what we really want to know. Suppose a child had an event reported by the nurse or parent that the pneumogram did not show. This controversy caused the next development — a method to measure the airflow and effort through noninvasive detection — called thoracic impedance, which became the accepted method for detecting periodic breathing and central apnea.

Thoracic impedance was accomplished when changes in the air/fluid ratio during airway movement were measured by the changes within the electrical resistance of an induced electrical field. But impedance pneumography was not perfect. Obstructive apneas, cardiogenic artifacts, low respiratory signal amplitude, sigh breaths, and lost signals could not be distinguished from central apnea from the data given. Thus, it caused problems by giving false-positive results.

In light of these problems, other methods were then considered, including thoracic and abdominal mercury strain gages, respiratory magnometers, respiratory inductive plethysmography, and abdominal pressure capsules. One of the most accepted methods now used for measurement of airflow involve the placement of small thermisters below the nares of an infant and in front of the mouth.

The thermisters, which are sensitive to fluctuations in the temperature, measure the changes produced during inspiration and exhalation. These changes produce an analog measurement of the electrical resistance in the thermister.

Another accepted method of airflow measurement is an old friend to the RCP. A sampling catheter is attached to the anterior nares and is connected to a CO_2 capnograph. This allows the qualitative signal for the expiratory flow, as well as the quantitative measurement of the end-tidal P_{aCO_2}.

With the use of either of the two airflow decimeters and the presence of thoracic impedance, both obstructive and central apnea can be detected. Now, along with the ability to detect apnea, we can detect cardiac arrhythmia and apnea associated cardiac decelerations (bradycardias) with both heart rate trend and V_2 lead waveform. We can now measure heart rate variability, which is used to determine quiet and active sleep times or sleep staging in infants.

Once again, however, another question arises. If a child is having an event, is he having oxygen desaturation associated with the event? The next kind of

monitoring added was transcutaneous monitoring of either PO_2 or CO_2. However, transcutaneous monitoring was slow in response time. Next, S_{aO_2} measurement with pulse monitoring — along with the pulse rate trending — allowed technicians a faster kind of measurement. If the pulse rate trend and the heart rate trend are not compared during the study, you may come up with false low oxygen saturations due to movement. These two parameters should be in synchronization. If they are not, then the O_2 saturation may not be accurate.

Soon, many of these methods were being called "sleep studies," which was misleading because they could mean almost anything to anybody.

Prior to everything that was happening with sleep studies for infants, the adult sleep study had developed around a neurological base. Staging was the foremost important area with the other physiological parameters developing secondarily. Most of these sleep studies (polysmonographies) were attended by a trained technician. The technician would make notes during the study so that the person scoring the test would understand what was happening in relation to body positioning, snoring, or replacing any electrode that may have been dislodged.

Soon, these parameters were being used for pediatric patients who had been screened with an abnormal two-channel pneumocardiogram. These studies were almost always in a large medical facility with a Level III neonatal intensive care unit. The demand for this testing increased at both the adult and pediatric level over the ensuing years.

Within the last ten years, the subject of adult sleep apnea has come into the forefront of the "new" diagnostic maladies. Of course, with the added exposure, the need increased to handle the number of studies ordered. However, other medical disciplines became involved, causing an overload to the existing sleep labs. Just like the magnetic resonance imaging units of the last decade, the sleep lab was the newest medical money-maker that everyone had to have.

One of the many problems that has occurred with the added exposure is that the medical director of the sleep lab is usually a neurologist. Most pulmonary physicians are not allowed to do their own interpretations. Often, if they do interpretations, they are not comfortable with the encephalogram (EEG), electro-oculogram (EOG), and electromyogram (EMG) parameters being used for sleep staging and other sleep anomalies. They look at the parameters of airflow, oxygen saturation, heart rate, effort impedance, abdominal strain gages, and ECG for their interpretation. So, basically, there are now two similar, but different, camps diagnosing apnea.

Equipment manufacturers soon saw the opportunity to provide their solutions to these problems. They also realized they would need to come up with something small enough to be portable. Along with the downsizing of the equipment came the addition of the portable laptop computer. The computer ran acquisition software, took the analog signals sampling, and stored this raw digital data either on the hard disk, floppy disk, magnetic tape, or optical disk using a "write once read many" (WORM) system.

Respiratory care professionals working as home care practitioners will be greatly affected by the changes taking place in the field of home sleep study.

The higher-end systems made ongoing software program updates to fine-tune their sleep study systems, and a number of these systems allowed notations to be made on screen while the test was being done. Therefore, the person scoring got a better idea of what was going on during these studies, which promoted increased accuracy in the scoring. Of course, these software programs developed into scoring systems, as well.

Even with these enhancements, sleep study equipment is not perfect. For example, it can score lost signals as real events and show low amplitude of the signals as apneas. But some manufacturers claim they have the perfect sleep study system: just set it up, walk away, take it back to the office later, have the software analyze the raw data, and print it out. Of course, these programs have a summary page that allows an overview of the finished product. If these summary reports are the only part of the test that is seen or if the physician doing the interpretation doesn't look at the graphic events to determine their validity, the test could be misinterpreted.

Also, without a technician in attendance during the study, some physiological data may be missed or wrongly scored. Thus, the interpreting physician may receive misinformation on what transpired during the sleep study.

Often, the technician performing the sleep study is the respiratory care practitioner who works for the home care company contracted for the testing. Why use a home care company? First, if the patient can undergo a sleep study in the home, it will save the expense of an overnight stay in the hospital, thus reducing the

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cost of the test to the patient or third party payer. Secondly, the overloading of the hospital lab by the increased ordering of this kind of study can cause a serious backlog of work.

Because there are no definite standards of practice in this area as of this writing, there has been a certain degree of abuse by some home care companies. The abuse was not malicious, but it was enough to prompt the American Medical Association (AMA) to begin forming standards of practice specifically for this area of diagnostic study.

The American Sleep Disorders Association (ASDA) also looked at the problem. It set up a standards committee under the chairmanship of Michael Thorpy, MD, director of the Sleep-Wake Disorders Center, in Bronx, NY. Dr. Thorpy is also an associate professor of neurology at Albert Einstein College of Medicine. Dr. Thorpy and his committee developed new standards of practice titled "Practice Parameters for the Use of Portable Recording in the Assessment of Obstructive Sleep Apnea." He presented the standards to the AMA this year. Within the 17-page document of standards, the committee addressed "...the current role of portable recording in the diagnosis, assessment, and management of obstructive sleep apnea in adults."

The committee's recommendations focused on unattended portable recordings conducted in non-laboratory settings. Their position covers the areas of equipment, personnel, advantages/limitations, definitions, and recommendations. Within the definitions portion of the document are the levels of "types of studies for sleep apnea evaluation (six-hour overnight recording minimum)."

The ASDA defined four levels of sleep study, using the standard polysomnography attended by trained personnel as Level I. The other levels were lesser studies regarding equipment and parameters and the attendance or nonattendance of trained personnel.

They recommended that standard polysomnography — or the attended sleep study — is the accepted test for the diagnosis and determination of the severity and treatment of obstructive apnea. They recommended that unattended portable sleep studies be accepted only in limited applications. Also, they specified a number of technical recommendations regarding which studies are acceptable for diagnosis and the assessment of therapy such as nasal continuous positive airway pressure (NCPAP) therapy.

They also made recommendations on how to study patients who cannot be studied in the laboratory, as well as body positioning during studies and the reproducibility of unprocessed raw data. Necessary personnel and operations of these studies were also documented.

The ASDA recommendations were presented to the AMA, which drafted the following position statement (and the appropriate CPT codes). The CPT codes are expected to go into effect Jan. 1, 1994. The AMA position statement reads:

"Sleep studies and polysomnography refer to the continuous and simultaneous monitoring and recording and pathophysiological parameters of sleep for six or more hours with physician review, interpretation, and report. The studies are performed to diagnose a variety of sleep disorders and to evaluate patient's responses to therapies, such as NCPAP therapy. Polysomnography is distinguished from sleep studies by the inclusion of sleep staging, which is defined to include a one to four lead EEG, an EOG, and a submental EMG. Additional parameters of sleep include:

1) ECG
2) Airflow
3) Ventilation and respiratory effort
4) Gas exchange by oximetery, transcutaneous monitoring, or end tidal gas analysis
5) Extremity muscle activity; motor activity movement
6) Extended EEG monitoring
7) Penal turnesence
8) Gastrophaegeal reflux
9) Continuous blood pressure monitoring
10) Snoring
11) Body positions"

For a study to be coded as polysomnography, sleep must be recorded and staged. Sleep staging determines which stage of sleep the patient is in. With the CPT codes recently released, here are the AMA's definitions of the levels of polysomnography and sleep studies:

— Polysomnography recording: Analysis and interpretation of multiple simultaneous physiological measurements of sleep.

— Sleep study: Three or more parameters of sleep other than sleep staging; attended by a technologist.

— Polysomnography: Sleep staging with one to three additional parameters of sleep; attended by a technologist.

— Sleep staging with four or more additional parameters of sleep; attended by a technologist.

Anything less than what is defined above will go through a long review process and probably will not be reimbursed.

Respiratory care professionals working as home care practitioners will be greatly affected by the changes taking place in the field of home sleep study. If RCPs want to continue to have a say in what is happening in this area, we need to join together to define our role in this field. When working in a field of expertise that has established specific standards, RCPs must work with these standards and help develop ones that will promote quality patient care and professionalism.

Since attended studies are going to be the rule in the very near future, we need to make a strong commitment to meeting the standards governing sleep studies as they continue to develop. •

Tim Schlose, a California-licensed respiratory care practitioner, is director of clinical services at Naptime Monitoring in Anaheim, CA, and a member of the National Association of Apnea Professionals, based in Waiane, HI.