Summary – Sleep Disorders
Dr. Matt Weiss

Introduction

Dr. Weiss brings a sound medical background to his expertise in Sleep Medicine. He received his undergraduate degree in philosophy from Dartmouth College and his medical degree from the University of Illinois College of Medicine. He trained in the Harvard Combined Pulmonary & Critical Care Medicine Fellowship Program, then in the Harvard Medical School Division of Sleep Medicine at Beth Israel Deaconess Medical Center and Children's Hospital. Dr. Weiss is board certified in internal medicine, pulmonary medicine, critical care medicine, and sleep medicine. His current practice at Harbor Medical Associates includes the directorship of the sleep medicine program at South Shore Hospital in Weymouth, Massachusetts.

Normal Sleep

Scientists don't completely understand why we sleep, but we do know that all animals require sleep -- though in differing amounts and at different times and cycles. To best understand the function of sleep, we should look at what happens when we are deprived of it. Sleep deprivation affects humans both physically and psychologically -- to the point that you can actually lose touch with reality. The systemic effects of sleep deprivation include a lack of cell repair, a decrease in or lack of growth hormone secretion, and decreases in other hormone secretions. The body tries to make up for this by "up regulating" stress-related hormones, which then cause an increase in metabolic activity and an accompanying increase in stress. People with mitochondrial disease are particularly affected by sleep deprivation since they already have difficulty with oxygen and energy production.

There are two main types of sleep: **NonREM** and **REM**. REM Sleep (**R**apid **E**ye **M**ovement) is characterized by "twitching eye movements" and can be studied using EEGs (electroencephalograms), which measure brain waves. NonREM was identified as the absence of these movements. REM sleep is apparently necessary for learning new facts and consolidating memories. We dream during REM sleep but the body is more or less paralyzed. NonREM sleep is categorized into three phases: N1, shallow sleep; N2, progressing into a deeper sleep; and N3, slow wave sleep. The more quiescent the body, the more repair mechanisms work, the more restorative actions occur, and the more growth hormone is secreted. Specific mechanisms make you sleepy. In **Process S (homeostatic sleep drive)** by-products of cellular metabolism, adenosine -- a chemical found in the heart and brain -- accumulates. By the end of the day, you have accumulated enough adenosine to make you sleepy -- and as you sleep, adenosine is slowly cleared away. Caffeine inhibits the release of adenosine, thus inhibiting sleep. If adenosine is not cleared, there is no REM sleep and you don't feel refreshed. About three nights of good sleep will catch you up on sleep deprivation.

Process C (circadian sleep drive) relates to our circadian rhythms. Usually people feel most sleepy between 2-4 a.m. and 2-4 p.m. Research shows that more deaths and auto accidents occur between 2-4 a.m.

Sleep Disorders

Breathing Disorders

S*leep apnea* causes you to stop breathing or decrease breathing for short periods of time. This is measured by observing air flow from the nose and exhaled from the mouth. Using a pulse oximeter (a device that fits over your fingertip), normal breathing would register oxygen at 90-100%. An oxygen level below that amount for 10 seconds or more indicates obstructive sleep apnea. The obstruction causes the air passage to become narrower. Snoring relaxes the muscles in the upper airway, thereby decreasing the diameter of the airway and forcing air to move more quickly through the passage. While snoring can be innocent, research shows that it can be associated with increases in cholesterol buildup in the carotid arteries and the risk of a stroke.

Upper airway resistance can cause a disruption of sleep or sleep fragmentation, but with no decrease in oxygenation and with or without snoring. You may wake up tired because your sleep may have been disrupted anywhere from 20-120 times an hour. Any intrusion into sleep causes *alpha wave intrusions* that will prevent you from entering into a deeper, more restorative sleep. The disturbances can be anything from a change in breathing pattern to pain to loud noises. Even in the absence of decreased oxygen, these sleep disruptions can cause more metabolic stress, especially for those with mitochondrial disease.

Obstructive sleep apnea in an adult causes intermittent (usually five or more episodes per hour) hypopnea (decreased breathing, therefore decreased oxygen). Measurement tools include the Apnea Hypopnea Index (a measure of the actual decrease in the percentage of oxygen) and the Respiratory Disturbance Index (a more subjective measure of sleep fragmentation).

More severe cases of sleep apnea are called *obesity hypoventilation* or Pickwickian Syndrome. The morbidly obese may suffer from such severe sleep apnea that they actually have an increase in carbon dioxide during the daytime that causes red-flushed cheeks. Great fluctuations in the amount of oxygen that gets to the cells causes the production of more free radicals and other toxins, thereby causing more stress on cells.

In *central sleep apnea*, sleep is disrupted when your body fails to initiate the effort to breathe; it is neurologically or brain related. This may also be related to sensors in the carotid arteries or the medulla (a part of the brain) that sense oxygen/carbon dioxide in the blood. Heart failure may also reduce the ability to move oxygen through the body and brain and for it to sense the carbon dioxide/oxygen levels; it is actually the level of carbon dioxide in our bloodstream that triggers us to breathe. Patients with this syndrome either breathe too much or not at all. Central sleep apnea is more difficult to

diagnose than obstructive apneas.

Complex sleep apnea first appears to be obstructive apnea but converts to more central apnea. This is a recent discovery.

Treatment will depend on causes, and *diagnosis* starts with a good history and sleep study. A variety of means exist to study sleep apneas. Overnight oximeters measure oxygen saturation. While home sleep tests do not measure sleep -- they measure respiratory effort and oxygen air flow -- they can be helpful. The gold standard, however, includes a polysomnogram. An EEG measures your brain waves while sleeping through electrodes placed on your head. Ideally done in a sleep laboratory, this test also includes other means to measure eye movements, air flow through the nose and mouth, snoring, respiratory effort, oxygen saturation, and even leg movements.

Once the specific sleep disturbance is determined, treatment can begin. Until the 1980s, the only treatment for obstructive apnea was a tracheotomy in order to bypass the upper airway. In the 1980s in Australia, **CPAP** (continuous positive airway pressure) was invented, providing a continuous flow of air pressure to keep the airway open. **BIPAP** (bilevel positive airway pressure) allows for two different air pressures - one for inspiration, one for expiration. These are particularly helpful for patients who have pressure on their airways from either morbid obesity or neuromuscular disorders. Adaptive ventilators, which can be used for central sleep apnea, are more complicated devices; they are "smarter" than either CPAPs or BIPAPs because they adapt to your specific needs and don't over-breathe you. **Surgery**, i.e., a tracheotomy, is the most radical treatment. For children, a tonsillectomy may help, whereas for adults, surgical removal of other soft tissues in the airway can be helpful. These are considered more radical treatments if other treatments have not worked. Specialty dentists can provide **oral devices**. There are also some newer **drugs** being tried, especially for those with central sleep apnea.

<u>Movement Disorders</u>

Restless leg syndrome, among other conditions, causes uncomfortable movement during sleep. Patients are aware of the disruptions to their sleep. Other syndromes, like *periodic leg movement syndrome* and *rhythmic movement disorders* in children (such as head banging and limb movement), cause disruptive movements during sleep that the patient is not aware of. Deficiencies in either Vitamin B12 or iron need to be ruled out, especially for restless leg syndrome. Peripheral neuropathies can be caused by malabsorption conditions as well. For these movement disorders, options include behavioral treatment first, which means getting up and walking, compression, then medications. Dopamine-type drugs, like those used for Parkinson's disease (but in much lower doses), and anti-epileptic drugs, can also be effective; opiates like oxycodone should be a last resort. However, often drugs themselves can cause these movement disorders.

<u>Circadian Rhythm Disorders</u>

The human body has a natural flow of ups and downs; for most people the low points are generally between 2-4 a.m. and 2-4 p.m. The physiology of brain chemistry makes us night owls or early birds. Certainly, things like jet lag, changing time zones, shift work, and exposure to bright light can affect our circadian rhythms. Because people with cortical blindness are never exposed to light, they do not have a natural sleep cycle.

Again, the key to diagnosis is a good history, and it is important to ask what your schedule is like on weekends and weekdays. In a lab setting, melatonin levels and circadian rhythms can be measured. Treatments involve behavioral interventions (changing work/weekend schedules), light exposure (shutting off TVs and computers earlier in the evening), giving melatonin as a medication (but this must be done carefully). Melatonin must be given two hours prior to spontaneous bedtime for it to work properly.

Hypersomnia (excessive sleep like narcolepsy and other conditions)
Various syndromes may cause you to have an excessive need for sleep. Real narcolepsy, which is rare, causes you to actually loses muscle tone; it may be an autoimmune disorder. There may be a disease or traumatic cause for narcolepsy, such as trauma to the hypothalamus. Diagnosis can be made through a daytime sleep test; treatment is usually with medications that are stimulants.

Parasomnia

This refers to abnormal sleep behaviors like night terrors or sleep walking.

REM Behavioral Disorders

These usually occur among older adults and are characterized by aggressive behavior during dreams. It is often confused with post-traumatic stress disorder, so a good history is essential. Treatment is usually behavioral but melatonin also may be helpful.

Seizure Disorders

This complex condition usually occurs in the early part of the night during NonREM sleep. It can be treated with antiepileptic drugs.

Sleep Disorders & Mitochondrial Disease

Because fatigue is a common symptom of mitochondrial disease, looking into sleep disturbances/disruptions is important for Mito patients. Sleep deprivation is both caused by symptoms and can cause more symptoms. Because sleep is required for cell restoration, it is essential for Mito patients, but symptoms of pain, limb movements, and decreased oxygenation can cause sleep disruptions. A good history is needed to determine the cause (i.e., breathing, limb movements, pain, etc.) before a treatment is recommended. Large academic centers in the United States have sleep centers or sleep medicine programs that can help diagnose and treat sleep disturbances.

Submitted by Joanne M. Turco, RN, MS & Cristy Balcells RN MSN