Attention Deficit Disorders and Sleep/Arousal Disturbance

THOMAS E. BROWN[a] AND WILLIAM J. McMULLEN, JR.[b]

[a]*Clinic for Attention and Related Disorders, Yale University School of Medicine, New Haven, Connecticut 06519, USA*

[b]*California Pacific Epilepsy Center, San Francisco, California 94115, USA*

ABSTRACT: Many children, adolescents, and adults with Attention Deficit Disorders report chronic difficulties with falling asleep, awakening and/or maintaining adequate daytime alertness. These problems may be due to a variety of factors, including environment, lifestyle, and psychiatric comorbidities. Impairments in sleep/arousal may also be related more directly to the underlying pathophysiology of ADD. This chapter describes clinical manifestations of sleep/arousal problems often associated with ADD and reviews behavioral and medication options for treatment.

KEYWORDS: ADD; ADHD; Sleep disturbances; Sleep disorders.

INTRODUCTION

Attention deficit disorder (ADD)[c] is a relatively common disorder with a reported prevalence of 3 to 5% in the general population of children.[1] It has been suggested that 30 to 50% of those children with the disorder will continue to experience symptoms into adulthood.[2]

Sleep disturbances include difficulties in falling asleep, difficulties in awakening, and difficulties in maintaining adequate alertness for daily activities (excessive daytime sleepiness). In the general population, sleep disturbance is even more common than ADD, with prevalence estimated to range from 25 to 43% in children,[3–5] 12% (severe disturbance) to 37% (occasional sleep disturbance) in adolescents,[6] 12% (severe) to 26% (some disturbance) in a general German population,[7] and up to 42% in middle aged women.[8]

Given the above, it is not surprising that a fair degree of overlap exists between these two disorders, though the rates of sleep disturbance in children with attention deficit/hyperactivity disorder (ADHD) is much higher than one would expect even given the high prevalence of sleep problems in the general school-age cohort. Ball *et al.*[9] have reported that more than 50% of children with ADHD have difficulty falling asleep. Stein[10] reported that moderate to severe sleep problems occurred at least once a week in nearly 20% of children with ADHD compared to 13.3% of psychiatric controls, and 6.2% of pediatric controls.

Address for correspondence: Thomas E. Brown, Ph.D., 1188 Whitney Avenue, Hamden, CT 06517. Voice: 203-562-5713; fax: 203-562-3465.
TEBrownyu@aol.com

[c]In this paper, the term Attention Deficit Disorder is used to refer to all three subtypes of ADHD recognized in the DSM-IV.

One possible explanation offered is that some children diagnosed with an attention deficit may suffer from a primary sleep disorder such as narcolepsy, either as an alternate diagnosis or as an additional diagnosis.[11–13] It is unlikely that the majority of individuals with attention deficit disorder and sleep disturbance suffer from a primary sleep disorder, however, and so an alternate explanation would appear to be in order.

In looking at the issue of sleep disturbance in individuals with ADD, it has been suggested that the high frequency of sleep/arousal disturbances reported by persons with ADDs may be related to the close linkage between brain systems involved in regulation of sleep/arousal and those involved in the regulation of attention and affect.[14] Dahl identifies the prefrontal cortex as playing a critical role in the regulation of arousal, sleep, affect, and attention.[15] Mirsky provides a cogent discussion of this topic in this volume as well.[16] From this point of view, developmental impairment in either of these domains may well incur impaired functioning in the other.

Dahl[15] describes sleep and arousal as the polar extremes of a single continuum where sleep is "... a categorical diminution of awareness and responsiveness to the environment" in contrast to "a state of high responsiveness (vigilance) ... a high arousal state [that] precludes the ability to sleep." (p.4) There are substantial developmental changes in sleep patterns as individuals mature from infancy through adulthood and on to old age. The balance of sleep and wakefulness is integral to these changes and shifts from greater periods of sleep in infancy to more evenly balanced sleep/wake cycles in adulthood.

Many individuals who suffer from attention deficit disorders report that they are not able to develop or maintain developmentally adequate balance between sleep and wakefulness. Not only do they complain of chronic difficulties in falling asleep and/or awakening, many also report chronic difficulties in attaining and maintaining alertness and arousal. The overlap between the subjective experience of decreased vigilance and lowered arousal/activation is such that many patients who report decreased motivation or vigilance may actually be experiencing lowered arousal, and vice versa.

Perhaps surprisingly, given the prevalence of sleep disturbance noted above, there has been a dearth of adequate data on the comorbidity of sleep disturbance and ADD. Most discussions of ADD do not incorporate disturbance of sleep or arousal in conceptualizing the disorder. Yet it seems likely that further research could well yield evidence to support and explain frequent clinical reports from patients suffering with ADD regarding chronic difficulties in achieving and sustaining alertness, as well as chronic sleep disturbance.

Whatever the mechanisms, many clinicians working with children, adolescents, and adults with attention disorders have found that complaints of sleep disturbance are quite frequent and often warrant clinical attention because inadequate sleep or alertness can significantly exacerbate cognitive and behavioral symptoms associated with ADD.[17]

The present chapter describes three sleep disturbances commonly associated with ADD; discusses how these might be related to currently emerging understandings of ADD; and suggests several treatment interventions that may be useful in persons whose ADD is accompanied by a comorbid sleep and/or arousal disturbance.

DIFFICULTIES IN FALLING ASLEEP

It is not at all uncommon for parents of children with ADD to report that from infancy their child has had great difficulty in getting to sleep. Sometimes these reports are linked to anxiety or depression, but often this is not the case. In children, parents often elaborate that their young child is unable or unwilling to take a nap, even when obviously exhausted. Some describe battles every evening with a child who is overtired and unable to settle into sleep until absolute exhaustion has set in. Many clinicians have documented these difficulties in young children with ADD who have these chronic problems in settling into sleep.[18–23]

Reluctance or inability to settle into sleep at a designated time may be due to many different factors.[24] For some it may be simply lack of an adequate routine for gradually tapering down the level of activity and stimulation near the end of the day. For others it may relate to ineffective or inconsistent behavioral reinforcement patterns. Yet some children are often unable to get to sleep at an appropriate time even when parents have worked hard to establish appropriate routines. It is often not easy to disentangle factors contributing to a child's chronic difficulty in getting to sleep because they may relate to a variety of external factors (e.g., reinforcement patterns, activating activities occurring too late) as well as internal factors (disposition, physiological factors in sleep onset and arousal mechanisms).

Chronic disturbances in falling asleep are characteristic not only of children with attention deficit; many adolescents and adults with ADD have similar complaints. Difficulties in falling asleep, as in children, may be linked to external factors, internal biological factors, or both.

Adolescent and adult patients too may suffer from inadequate wind-down routines to prepare for sleep or from ruminative worry, or from evening family conflicts. Some report that they remain awake primarily due to becoming distracted by activity that is inconsistent with sleep (reading, surfing the internet, socializing). For some it is actually easier to concentrate in the evening when background environmental stimulation may be reduced relative to the targeted activity. Attempts at daytime attention to target material may be thwarted by frequent interruption by distracting background activity, while evening activity is both more stimulating than sleep (e.g., *it* is the distractor), and less often interrupted by competing stimuli. These patients sometimes are able to fall asleep when they so engage, but establish behavior patterns over time that preclude adequate sleep. Others may attempt to self medicate sleep disturbance by using over the counter sleep aids or alcohol. These attempts are often less than effective because they may not work, they may contribute to exacerbation of attention problems, and they may alter the quality of sleep attained.[25,26] Attention to proper sleep hygiene (discussed later in this chapter) and avoidance of potentially maladaptive behavior patterns may offer some relief from problems falling asleep in these patients.

Other patients with ADD report a lifelong pattern of consistently becoming more alert in the evening, feeling more energized and more ready to engage in work or social activities after dark than in the daytime. These individuals often describe a pattern of difficulty falling asleep until very late at night; as preschoolers they may not have been able to settle and fall into sleep until 10 or 11 P.M. most nights. As adolescents or adults they may chronically feel restless and unable to sleep until 2 or

3 A.M. or later. Attention to proper sleep hygiene may help these patients, but they may continue to experience delayed onset of sleep due to internal restlessness, even in the absence of maladaptive behavioral patterns.

At present, it is not clear how these problems in getting to sleep are related to the pathophysiology of ADD. Dahl has emphasized that there is a strong relationship between the control of sleep and the regulation of mood and behavior in waking states, yet he notes that "Our current knowledge of these complex relationships between sleep, development and psychiatric well-being is at an embryonic state."[17] These issues are discussed later in this chapter.

DIFFICULTIES IN AWAKENING

Not surprisingly, persons who chronically stay up very late, whether because they chose to or were simply unable to get to sleep earlier, often report chronic difficulty in morning awakening. Although individuals vary widely in the amount of sleep they require, each person has some minimum requirement, which if not achieved leads to ineffective functioning during daily activities. Difficulties in matching biological circadian rhythms to the realities of social needs, especially during adolescence, are discussed by Ferber.[27]

Some "night-owls" are fortunate enough that they can arrange their schedule for work, classes or other obligations in a way which usually allows going to bed late and getting up late so they can meet at least their minimal, if not their optimal sleep requirements. Most are not so fortunate; given the general societal pattern of daytime wakefulness and work production, they often find themselves trying to function on insufficient sleep. This is likely to exacerbate their ADD-related cognitive deficits and further impair their functioning. A wealth of research has shown deleterious effects of sleep deprivation on cognitive functioning even in non-ADD subjects.[28–31]

Difficulty with morning awakening is not limited to persons who stay up excessively late due to insomnia or behavioral patterns inconsistent with sleep. A fair number of individuals with ADD report that they have chronic difficulty in awakening, even when they have had adequate sleep the night before. They note that they tend to sleep very soundly and are often unresponsive to the loudest of alarm clocks or strenuous efforts of others to awaken them.

Chronic difficulty in awakening can cause persistent stress in a household where one or more members of a family is daily burdened with the protracted task of urging, pleading or trying to force a sleepy, resistant person out of bed and into morning routines to prepare for work or school. In addition to family stresses, severe and persistent problems of this sort may have substantial consequences for the affected individual in work or school. Many high schools withhold academic credit for courses where a student has been late to class too many times. College students may fail courses where their chronic difficulty in getting up for morning lectures or exams is too persistent. Employees may lose their jobs if they repeatedly fail to get to work on time.

Despite determination to avoid such consequences, many persons with ADD have chronic difficulties in getting themselves awake and out to school or work on time. Many affected persons do not live with someone who is able and willing to provide

reliable daily wakeup service. Even when there is a person available to assist the patient in awakening, they may not be able to provide this assistance consistently, or their efforts may fail. One family complained of how they often struggled for almost an hour to wake up their adolescent son, get him on his feet, undressed and into the shower, only to find him shortly afterward soundly asleep as he sat on the floor of his shower with water pouring over him.

Clearly, there may be multiple etiologies for this problem with awakening despite adequate sleep. These may include mood disturbance, motivational issues, family systems issues, and physiological contributions.

DIFFICULTIES IN MAINTAINING ALERTNESS

The third type of sleep disturbance often reported by persons with ADD, especially those with the predominantly inattentive type, is difficulty in staying alert when not engaged in stimulating mental action or lively physical activity. Many persons with an ADD diagnosis note that even when they are adequately rested, they often have much difficulty in staying alert if they have to sit still or do a routine or un-stimulating task. These individuals report that even after a very adequate night's sleep they tend quickly to become very drowsy when they sit still to attend a meeting, to listen to a lecture, to read a book or, for some, to drive a car.[32,33] At such times these persons find that they have to keep moving about, changing activities, or giving themselves frequent breaks in order to avert falling asleep. Some college students report repeatedly falling asleep in lectures, even when well-rested and wanting to take good notes so they could be prepared for an imminent exam. Some working adults report repeated yawning and having to persistently fight sleep during important business meetings, even when they are aware of being in clear view of their colleagues and supervisors. Often these individuals note a sudden improvement in their level of alertness as soon as they get up and start moving or if something exciting occurs to liven up an otherwise boring activity. They emphasize that their drowsiness seems not to be a pervasive sense of fatigue such as occurs when they have had insufficient sleep. Instead, it appears to be an inability to maintain a sufficient level of alertness or arousal unless engaged in significant physical movement or in mental activity that they find consistently stimulating. Thus, in addition to difficulty sustaining *attention*, they report difficulty sustaining *arousal*.

The most extreme form of this difficulty in maintaining alertness is narcolepsy. Yoss,[12] Navalet,[11] and Dahl[13] have each studied individuals carrying diagnoses of both ADD and narcolepsy. Some of their cases suggest that children or adolescents with narcolepsy can be misdiagnosed as having ADD. Others are more consistent with concurrent disorders.

Another approach to conceptualizing ADD with chronic problems in maintaining alertness has been suggested by Weinberg and Brumback[34] and Weinberg and Harper[35] who proposed the term "primary disorder of vigilance" to replace the diagnosis of ADD for describing a syndrome involving inattentiveness, boredom, restlessness and sleepiness. They presented case studies to illustrate how individuals with this syndrome tend to be hyperactive in order to ward off drowsiness; their

articles observe that these persons tend to fall asleep several times daily if not adequately stimulated.

Weinberg[35] claims that persons with primary disorder of vigilance do not have the type of sleep-attacks characteristic of narcolepsy, but he does not report use of the blood test commonly used in differential diagnosis of narcolepsy.[36,37] Weinberg reports that primary disorder of vigilance responds well to treatment with the stimulants commonly used to treat ADD. Thus far, Weinberg's case reports have called attention to the overlap of some cases of ADD with excessive daytime somnolence and other aspects of impaired vigilance, but he has not yet established a case for his alternative diagnostic category.

Data regarding the chronic problems of persons with ADD in maintaining alertness can be found in the manual for the *Brown Attention Deficit Disorder Scales*[36] for adolescents and adults. These self-report scales, developed from interviews with individuals who met DSM diagnostic criteria for Attention Deficit Disorders, query chronic problems in maintaining alertness, energy and effort for work tasks and chronic problems with sustaining attention and concentration in addition to other clusters of ADD symptoms. Clusters of items related to chronic difficulties in maintaining alertness and effort for work and of items related to problems in sustaining attention and concentration correlated quite well (.80 and .85) with total scores for ADD symptoms in adolescents and in adults with diagnosed ADD. These data suggest that chronic problems maintaining alertness may be an important aspect of ADD symptoms for many who meet established diagnostic criteria for ADD.

The notion that ADD intrinsically involves dysfunction in regulation of arousal or an impaired ability to sustain alertness is not new. Virginia Douglas included "regulation of arousal and alertness to meet task demands" among the aspects of self-regulation she considered impaired in ADD.[38] Yet this important area of difficulty is often overlooked.

ADDITIONAL SLEEP ABNORMALITIES NOTED IN STUDIES OF ADD

Formal studies of the sleep of patients with ADD have not yielded consistent results. Polysomnographic studies of ADD within sleep labs have not produced consistent data to support the complaints of individuals with ADD regarding sleep disturbance. Time to sleep, sleep efficiency, and movement during sleep have all been studied and contradictory results have been found. Findings that have been documented in the literature on ADHD and sleep include increased latency to REM onset,[39] decreased latency to REM onset,[40] and decrease in overall REM activity.[18] Other polysomnographic abnormalities include an increase in delta-wave sleep[41] and sleep spindles.[42] Irregular sleep behaviors include excessive movement, frequent awakenings and general restless sleep.[21,39,41,43] Simmonds and Parraga also showed an increase of head banging and snoring among those with ADD, as compared to controls.[43]

Corkum *et al.*[23] have discussed some factors that may contribute to this lack of confirmatory data from laboratory studies. These factors included small sample sizes, lack of exclusion diagnostic criteria, inconsistent diagnostic criteria, inadequate control procedures, and heterogeneity of sleep parameters.

More recently, Gruber *et al*.[44] looked at the night-to-night *variability* of sleep in boys with ADD as compared to a normal sample. They hypothesized that the instability of the sleep-wake system was characteristic of ADHD and that the standard practice of averaging sleep measures across study nights was eliminating an important source of variance and assigning it to error variance. They used actigraphy to assess sleep in children with and without ADHD over five consecutive nights at home. This involved having subjects wear a wristwatch-like device on the nondominant hand that collected data for analysis by computer including sleep onset time, total sleep period, sleep percent, true sleep time, longest sleep period, quiet sleep, and number of night awakenings > 5 minutes. They found greater variability in ADHD sleepers as compared to normal controls, in support of their hypothesis that instability of the sleep-wake system is characteristic of children with ADHD.

DIFFERENTIAL DIAGNOSIS OF ADD AND SLEEP-AROUSAL DISORDERS

It has been suggested by some researchers that primary sleep disorders may sometimes be misdiagnosed as ADD. They observe that daytime behaviors of those with a wide variety of sleep disorders (e.g., sleep apnea, narcolepsy, periodic leg movements of sleep, sleep schedule disorders, insufficient sleep) can mimic ADD by manifesting short attention span, hyperactivity, and impulsivity.[27,45] This view is consistent with that of Navelet,[11] of Dahl *et al.*,[13] and of Kotagal and Swink.[46]

Narcolepsy is not the only sleep disorder that may be missed in favor of an ADD diagnosis. Other clinicians have noted that restless leg syndrome (RLS) and periodic limb movement syndrome (PLMS) are disorders that may be misdiagnosed as ADD.[47–50] Hickey, Walters and Hening[47] report three case studies of children with RLS who were misdiagnosed with ADD. Picchietti and Walters[49] reported that 34% of a group of children with ADHD had sufficient symptoms of PLMS to qualify for that diagnosis. Brooks[51] reports that sleep apnea can often be misdiagnosed as ADD because many children with sleep apnea are often hyperactive. Likewise, Ferber and Kryger[27] claim that sleep apnea can cause impaired daytime alertness and hyperactivity that may lead to an ADD diagnosis.

It remains to be determined whether the overlap of these patients with ADDs and concurrent sleep disorders is due to misdiagnosis or to a genuine comorbidity of ADD with these various disorders of sleep, or to a common pathophysiology of the mechanisms for self-regulation of sleep and waking-time behaviors. Systematic studies are needed to address these questions.

ASSESSMENT AND EVALUATION OF SLEEP-AROUSAL DISORDERS

At the clinical level, careful assessment of each individual with complaints of ADD symptoms or sleep disorder symptoms is needed to determine whether the primary diagnosis is ADD, a sleep disorder, or both. For assessment of sleep disorders in children and adolescents Ferber[27] has published an excellent protocol; the book by Sheldon, Spire and Levy[52] includes a useful appendix guide for differential diagnosis.

The cornerstone of effective intervention in any disorder is a thorough assessment, and ADD-related sleep disturbance is no exception. It is important to take a thorough history of the nature and course of the patient's difficulties with sleep and arousal. Inquiry about the usual time to bed, time to sleep, frequency and duration of awakening during sleep, degree of difficulty in awakening, early morning awakening, snoring, nightmares, etc., should be undertaken. Inquiry into the frequency and severity of daytime drowsiness, and the frequency and duration of any naps taken during the day is important. Information on the presence of any environmental stressors is important, especially if a stressor can be linked temporally to the onset of sleep disturbance. For example, if it is reported that a child has slept reasonably well until a pattern of difficulty falling asleep began several months ago, it is important to inquire about other changes in the child's life that may have occurred about the same time, e.g., sickness of a family member, parental divorce, a burglary in the neighborhood, etc.

Another important area of inquiry is in regard to the nature of the child's behavior when they do not sleep, and the reaction of family members to that behavior. Is there frequent conflict within the family regarding the child's sleep disturbance? Do parents unwittingly reinforce non-sleep behavior by allowing the child to stay awake and watch television with them, or play games with them late into the night? Is the reaction extremely negative, such that the child is further energized by anxiety over parental scolding at bedtime? In adults, are there identifiable maladaptive behavioral patterns that are inconsistent with sleep? Have there been attempts to modify behavior by the parents (in the child) or the patient (in the adult) and what has the outcome been? If the modification failed, is there an identifiable reason for the failure? Are various family members differentially committed to improving the sleep of the affected person?

If symptoms surface that could represent a primary sleep disorder such as narcolepsy, referral to an appropriate professional and/or sleep laboratory is indicated. It goes without saying that patients suffering from sleep disturbance should be screened for depression and undergo physical examination by their physician prior to attributing the disturbance to ADHD.

TREATMENT INTERVENTIONS FOR SLEEP DISTURBANCES WITH ADD

Difficulty Falling Asleep: Sleep Hygiene

Sleep hygiene refers to the arrangement of environmental and behavioral factors preceding sleep. Attention to these factors or maintaining proper sleep hygiene, is known to facilitate sleep. If the assessment suggested above indicates a significant chronic problem with falling asleep, e.g. sleep latency of more than 30 minutes on most nights, then the first step to be suggested is a review of bedtime routines to determine whether appropriate behavioral measures are being taken.

Maintaining a consistent bedtime, and regularly following a routine that allows the patient to gradually reduce their level of activity and move toward relaxation, may help those with difficulty falling asleep. For children, this may include taking a warm bath and then brushing teeth, getting in pajamas, having a story read by or with

a parent, quiet conversation while a parent gives a back rub, engaging in relaxing imagery, etc. For adolescents or adults it might mean watching television, reading enjoyable magazines or books, listening to music, etc. It is important in planning such activities that the patient not engage in activities like watching television or reading *while in bed*. We do not encourage patients with sleep disorders to have a television in the bedroom. However relaxing the patient may rate attention-demanding activities like reading or watching television, repeated exposure to trials of maintaining alertness to "make it to the end of the story" while lying in bed may condition the body to hold onto wakefulness even while in bed. What is needed is to repeatedly condition the body to *sleep* in bed so that the bed becomes the cue for sleep onset. This kind of conditioning is well known in other semi-voluntary activities such as bladder control. Many a traveler has experienced the dramatic increase in urinary urgency that accompanies entering a restroom after a long trip, though the matter was much less urgent while driving on the highway. Similar conditioning occurs with regard to sleep.

Elimination of activating stimuli in the bedroom at night is also encouraged (e.g., loud music, video games, etc.). In adults, encouraging only sleep or lovemaking in bed is important in counseling those with sleep-onset disorders. One question that arises is what should patients do if, after trying to sleep for an extended period, they just cannot fall asleep? We encourage the patient to arise and engage in minimally activating behavior outside of the bedroom (e.g., reading) and then after 20 to 30 minutes returning to the bedroom (without the book) to again try sleeping. Sometimes a glass of warm milk or chamomile tea is said by patients to be helpful. Minimizing time spent lying awake ruminating about sleep is the goal of getting the patient who cannot sleep out of the bedroom for a short time. Patients and families need to be instructed that these steps can only be expected to work if adhered to carefully over a period of months. The exacerbation of sleep disorder that is produced by poor sleep hygiene often takes months or years to develop; the patient should not expect that the solution will take less than several months to attain effectiveness.

Other aspects of sleep hygiene relate to setting. It is usually helpful if the bedroom is quiet, at a comfortable temperature, and adequately ventilated. Sound screens may muffle bothersome sounds and night masks may screen out excessive light.

Adequate exercise during the day and relaxation training may be helpful in reducing general stress levels that could contribute to sleep disturbance. Treatment of anxiety or depressive disorders may also be necessary if these are present.

Difficulty Falling Asleep: Medication

If adequate sleep hygiene is not sufficient to alleviate chronic problems in getting to sleep and there is no evidence of contributory emotional or family factors that can be directly addressed, the clinician may want to consider a trial of medication. However, before adding a new medication to address sleep problems it is important to be certain that the patient is not taking some medication (or caffeine or nicotine) that may be contributing to chronic difficulty in falling asleep. Elimination of alcohol use in adult patients may be helpful if this appears to be disrupting sleep patterns.[26]

Stimulants used to treat ADD may contribute to difficulties falling asleep in two different ways. Sometimes an individual with ADD who is responding well to

stimulant medication taken during the day may have insomnia resulting from taking a dose too close to bedtime. For most persons on stimulants an interval of at least 4 to 6 hours from ingestion of the last dose of the day will allow sufficient washout of the medication for sleep onset. Yet there are some who are able to get to sleep easily within just a few hours of taking a dose and others who need an interval of 6 to 8 hours or more from time of ingestion of their last dose before they are able to fall asleep.

Yet sleep of a person with ADD may also be delayed due to insufficient stimulant medication later in the day. Many clinicians still encourage patients to avoid taking a dose of stimulant in mid- or late-afternoon because they fear medication-induced insomnia. Often this plan backfires because of rebound agitation or irritability occurring in late afternoon or early evening after the last dose of stimulant has worn off. Kent, Blader, Koplewicz, *et al*.[53] have reported that administration of a late afternoon dose of methylphenidate tended to help alleviate ADD symptoms without adversely affecting sleep. Tirosh, Sadeh, *et al*. reported that methylphenidate given late in the afternoon tends actually to improve sleep for many patients with ADD. Clinicians whose patients taking stimulants for ADD are having chronic difficulty falling asleep should consider both of two possibilities: the patient may need less stimulant coverage in late afternoon or they may need an additional smaller dose in late afternoon or early evening.

When sleep hygiene measures are ineffective for a person with ADD and where stimulant medication does not appear to be causing the insomnia, and when chronic difficulty falling asleep is causing serious problems, there are some other options for intervention that have been reported effective. Brown and Gammon[22] reported a sequence of interventions for such ADD patients. Children with sleep latency in excess of 30 minutes who did not respond to sleep hygiene measures were given a trial of Benadryl (liquid or tablets) about one hour prior to sleep time. For some, this was sufficient to allow them to fall asleep. For a few patients, the antihistamine had a paradoxical effect of inducing agitation; in these cases it was immediately discontinued and the second step was taken.

The second level of intervention used by Brown and Gammon was administration of a small dose of clonidine (one-half of a 0.1 mg tab) given about 90 minutes before bedtime. Of 18 children (ages 6 to 17 years), one discontinued due to side effects (headaches). After 5 days the dose of clonidine was increased to 0.1 mg if sleep latency did not reduce to less than 45 minutes. Seven children remained on the 0.05 dose, while 10 increased to the full 0.1 mg dose. There was no correlation between the size of the dose needed and age or body weight. After 3 weeks the mean sleep latency for the group had reduced from the baseline of 1.9 hours to .5 hour.

More substantial samples of children and adolescents with ADD treated with clonidine for sleep disturbance have been reported by Wilens *et al*.[55] and by Prince *et al*.[56] Prince noted that in a systematic chart review of 62 cases where clonidine was used to treat chronic difficulty in falling asleep, 85% reported significant improvement maintained over a mean of 3 years. In this sample, no association was found between response and age group, gender, comorbid condition or concurrent pharmacotherapy; those whose insomnia existed prior to stimulant use and those whose insomnia was caused or exacerbated by stimulants responded equally well to clonidine given to help sleep.

Recently there has been some controversy about the combined use of stimulant medications with clonidine after a few case reports of sudden death in children who had been treated with this combination of medications. The FDA investigated and did not find sufficient evidence of a causal relationship to issue any warning. For a thoughtful discussion of this controversy and its implications for clinical practice see Cantwell[57] and Wilens *et al*.[58]

Other medications that have been reported useful for treatment of chronic difficulties in getting to sleep are tricyclic antidepressants and Trazadone. Tricyclic antidepressants (e.g., Desipramine, Nortriptyline) have been demonstrated effective for treatment of ADDs, although there is some question whether they have an impact on the cognitive symptoms as effectively as they do behavioral symptoms of ADD. These medications, often administered in a single dose at bedtime, are frequently helpful in alleviating chronic difficulties in getting to sleep. An alternative medication with demonstrated effectiveness for addressing insomnia in adults is Trazadone. Nierenberg *et al*.[59] have demonstrated that Trazadone, a sedating triazolopyridine antidepressant, is superior to placebo for persistent primary insomnia and for insomnia induced or exacerbated by antidepressants. Although their report did not assess patients with ADD, uncontrolled anecdotal reports indicate that similar results have been found in adults with ADD and severe, chronic difficulty falling asleep.

Difficulties in Awakening

When individuals with ADD chronically have severe difficulties in awakening, the first intervention is to be certain that they are getting adequate sleep. If an individual is chronically having difficulty falling asleep at a reasonable time, or is having very disrupted sleep, and is therefore getting insufficient sleep, it is not surprising if that person also has chronic difficulty in awakening. The first task is to assess factors that may be contributing to the difficulty in falling asleep or disruption of sleep, and to take appropriate remedial actions. This may include assessment for sleep apnea, narcolepsy, or other specific sleep disorders.

If a person is having great difficulty in awakening despite apparently adequate sleep, it may be useful to talk with them to ascertain whether they may be suffering from a mood disorder or to determine whether there may be some ambivalence regarding attendance at school or work. Such inquiry is especially important if the difficulty in awakening is of relatively recent onset rather than a lifelong problem. Sometimes difficulty getting out of bed is simple avoidance that needs to be addressed in terms of the specific factors sustaining the wish to avoid the activity. School phobia would be one disorder that might easily produce difficulty awakening.

Environmental modification may be helpful as a first step in treating difficulty awakening. Window shades should be open, allowing natural sunlight into the bedroom at daybreak. The room should be kept at a reasonable temperature; a very warm room may make it difficult to awaken. Setting two alarms, one 20 minutes prior to the primary alarm, may help to awaken the deep sleeper.

For those situations where the above measures fail or are incompletely successful, it may be useful to consider an early morning dose of stimulant prior to getting up for the day. Brown and Gammon[22] reported on a small sample of children and adolescents with ADD who had chronic difficulty in awakening that responded to their being awakened about 30–45 minutes prior to the time they actually needed to get

up. At that time, the parent administered a dose of stimulant to the child while he/she was still in bed. After taking the medication and a drink of juice or water, the child was encouraged to go back to sleep and was then reawakened 30 to 45 minutes later to get up and out of bed after the stimulant had time to take effect.

For college students or other adults who may not have someone living with them able or willing to awaken them for this early morning dose, the same approach has been used with a self-administration strategy. The patient is encouraged to obtain two alarm clocks as suggested above, setting one on a bedside table to sound 45 minutes prior to the actual wake-up time desired and the other on the opposite side of the room set to go off at the time the patient actually wants to be getting out of bed. When the first clock goes off, the patient awakens and self-administers the premeasured dose of stimulant that has been set out with a glass of water on the bedside table. The patient goes back to sleep and then responds to the second alarm clock by getting out of bed and walking over to turn it off. The reason for the second clock is that patients suffering this problem are often unsuccessful in accurately re-setting the bedside alarm clock before they go back to sleep.

Difficulties Maintaining Alertness

For patients with ADD who report significant chronic problems in maintaining alertness, the first task is to take a careful history to assess for depression and/or sleep disorders, e.g., sleep apnea or narcolepsy, any of which may be masked by ADD symptoms. As noted above, if there is reason to suspect a significant sleep disorder, referral to a specialist for a laboratory sleep study may be indicated.

Some patients with ADD and a history of chronic difficulty in maintaining alertness report that they are much better able to maintain appropriate alertness when their ADD is treated with stimulants. Often patients for whom maintaining alertness is an especially problematic symptom need more extensive coverage with stimulant medications than do other patients with a different ADD symptom profile. For example, they may need more closely spaced doses of stimulant to combat rapid excretion with rebound fatigue and/or they may need stimulant coverage for more hours of the day than many others with ADD.

Unlike some ADD patients who need stimulants only for times when they are working and are able to be without stimulants on non-work days, patients with chronic difficulties in maintaining alertness may need coverage of stimulant medications every day, especially for times when they are driving or socializing. In short, their use of stimulant medication more closely resembles the regimen generally used for treating patients with narcolepsy. For any patients whose symptoms are more complicated or who do not respond well to such treatment for ADD, a full evaluation by a specialist in sleep disorders may be indicated.

CONCLUSIONS

Problems in regulation of sleep and arousal appear to be an important feature of ADD. The finding that patients with ADD experience greater variability in sleep patterns is an important one and more research into the reasons for this variability needs to be done. It should not be surprising, given the current models of ADD as related

to dysfunction of dopaminergic frontal-subcortical circuits, that sleep regulation and arousal are frequently altered in ADD. The fact that stimulant medications treat the core symptoms of ADD and show side effects related to reducing sleep when administered too late suggests a common mechanism for reduced attention and reduced arousal. It is becoming clear that clinicians need to pay careful attention to sleep disturbance in patients with ADD, both because these disturbances may exacerbate other ADD symptoms and lead to worse daytime functioning, and because these sleep problems themselves may require focused assessment and treatment in order to improve the general quality of life of patients with ADD. Indeed, though daytime symptoms of ADD may pose difficulties for patients' families, sleep disturbance is often reported to be the most disruptive for the lives of family members. Proper attention to sleep disorder in the patient therefore may offer the most valuable intervention for ADD patients and their family.

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