TECHNICAL NOTE

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Sleep Apnea as a Possible Factor Contributing to Aggression in Sex Offenders*

ABSTRACT: Sleep disorders, such as obstructive sleep apnea (OSA), are often unrecognized and undertreated. A disruption in normal sleep may be associated with increased irritability and aggression. To elucidate further the impact of OSA on hostility of forensic patients, we performed a retrospective chart review of 10 consecutive outpatient sex offenders who were diagnosed with OSA and treated with continuous positive airway pressure (CPAP). The Buss–Perry Aggression Questionnaire was compared pre- and posttreatment. Following treatment, the total Buss–Perry score was significantly lower, with lower scores on the anger, physical aggression, hostility, and verbal aggression subscales. These results suggest that in sex offenders suffering from OSA, aggression and hostility may be significantly reduced through CPAP treatment. Further investigation is required to investigate if reducing aggression and hostility in this manner impacts recidivism and overall functioning.

KEYWORDS: forensic science, forensic psychiatry, sleep medicine, obstructive sleep apnea, aggression, hostility, sex offenders

Sex offenders are often characterized as impulsive, hostile, and aggressive. While these traits may be considered axiomatic for individuals who engage in criminal sexual activities, the cause of these problems remains unanswered. One possible contributing factor to hostility and aggression in some offenders could be the disruption of normal sleep by physical sleep disorders.

Obstructive sleep apnea (OSA) is a breathing-related sleep disorder characterized by a periodic cessation of breathing during sleep due to the collapse or blocking of the airway. Common symptoms include snoring and excessive daytime sleepiness (1). Other complaints may include restless sleep, daytime fatigue, lack of energy, mood problems, irritability, reduced libido, morning headaches, dry mouth, sore throat, and acid reflux.

Current treatments for this disorder include continuous positive airway pressure (CPAP), a dental device, adenotonsillectomy, and uvulo-palato-pharyngoplasty. It is estimated that OSA and its milder form, upper airway resistance syndrome (UARS), affects up to 20% of men in western cultures with 5% having significant symptoms (2). Many of these patients are undiagnosed. CPAP is the commonest effective treatment for OSA. It involves the

application of compressed room air into the nose, mouth, or both by means of a facial respiratory mask at all times when the patient is asleep. Typical pressures are from 8 to 13 cm of water. This pressure in effect "splints" the airway open during sleep, preventing collapse and allowing normal respiration. Sleep fragmentation and hypoxemia due to OSA are thereby normalized.

Psychological symptoms may be seen in OSA, including anxiety, hostility, and depression (3). However, little attention has been given to the relationship between sleep, hostility, and aggression in the forensic or psychiatric literature. Most published literature concerns individuals with intellectual disability. One study of 51 individuals with mental retardation and severe behavior disorders found significantly less total sleep and nighttime sleep compared with their nonbehaviorally disordered peers. As well, 88% were diagnosed with formal sleep disturbances (4). In a single case study of a 4-year-old girl with moderate intellectual disability, sleep deprivation was shown to increase levels of self-injury, but had no influence on aggressive behaviors (5). In another single case study, an association was observed between the sleep cycle and aggression in a blind, severely intellectually disabled boy (6). A third single case study showed that in an individual with severe mental retardation, aggression was more severe with sleep deprivation (7).

There have been only two reports on the relationship between treatment of OSA and problematic behavior in nonintellectually disabled individuals. Pakyurek et al. (8) described treatment of two children with OSA who had a significant decrease in aggression following surgery for the disorder. Dennis et al. (9) described an improvement in chronic assaultive behavior in a patient with paranoid schizophrenia and OSA following treatment with CPAP.

In order to test the hypothesis that OSA may be associated with hostility in sex offenders, a convenience sample consisting of the psychiatric records of sex offenders with objectively diagnosed OSA was retrospectively analyzed.

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Methods

This was a nonrandomized retrospective chart review of 10 patients with alleged sexual offences, of whom all attended the Sexual Behaviors Clinic at the Royal Ottawa Hospital in Ottawa, Ontario. All subjects were referred for assessment and treatment of sexually aberrant behavior. Inclusion criteria for the current study consisted of a completed sleep medicine consultation, diagnosis of and treatment of OSA, and a completed Buss–Perry Aggression Questionnaire pre- and post-CPAP treatment.

The Buss–Perry Aggression Questionnaire (10) is a well-validated self-report questionnaire consisting of 29 items rated from 1 (extremely uncharacteristic of subject) to 5 (extremely characteristic of subject) with a minimum possible score of 29 and a maximum of 145. It is an updated version of the original hostility inventory developed by Buss and Durkee (11). Self-reported scores have been reported to correlate with "peer nominations" on each of the scale items (n = 98): "Physical aggression" $r = 0.45$; "verbal aggression" $r = 0.20$; "anger" $r = 0.29$; "hostility" $r = 0.24$; and "total score" $r = 0.31$. In control populations, replicated factor analysis of the aggression questionnaire has yielded four factors (mean and SD for men shown): physical (mean = 24.3, SD = 7.7), verbal (mean = 15.2, SD = 3.9), anger (mean = 17.0, SD = 5.6), and hostility (mean = 21.3, SD = 5.5), as well as the total score (mean = 77.8, SD = 16.5). On this questionnaire, women's scores are generally lower.

All patients saw the same forensic psychiatrist (P. F.) and a majority saw the same sleep specialist (A. D.). Those patients evaluated by A. D. completed a pre-CPAP Beck Depression Inventory, 2nd edition (BDI-II) and Epworth Sleepiness Scale. It each case, the diagnosis of OSA was confirmed with polysomnography. Post-CPAP Buss–Perry Aggression Questionnaires were completed after CPAP had been titrated and patients verbally confirmed compliance. Compliance with CPAP administration was not objectively assessed. Similarly, it should be noted that the Buss–Perry Aggression Questionnaire is a self-reported instrument and reflects a subjective assessment of aggression. Concurrent use of medications, psychotherapy and other interventions were noted.

As part of patient intake, each patient signed a consent form to allow their clinical information to be used for research purposes, keeping their name confidential. Ethical approval was obtained from our institution Ethics Review Board for this retrospective review.

Data Analysis

Buss–Perry scores were analyzed using SPSS 12.0. Individual pre- and post-CPAP scores were compared using paired two-tailed t-tests. Pearson correlations were performed between age, sleep parameters, questionnaires, and Buss–Perry scores. Results with $p < 0.05$ were considered significant.

Results

Demographic Information

The test population included nine men and one woman. Two of the subjects had intellectual disabilities. Seven had been convicted of charges, including sexual assault, sexual interference, assault, kidnapping, invitation to sexual touching and selling child pornography. Three patients were referred from outside of the legal system, including one for pedophilia and sadism, one for sexual addiction, and one for pedophilia.

TABLE 1—*Pre-CPAP results.*

Parameter	Mean ± SEM	Normal Values
Beck Depression Inventory II	20.7 ± 4.6	<10
Epworth Sleepiness Scale	13.4 ± 1.8	<10
Body mass index (kg/m^2)	37.2 ± 1.8	18.5–24.9
Sleep indices		
PLM (#/h)	5.3 ± 2.7	0–5
AHI (#/h)	29.0 ± 7.4	<5
RDI (#/h)	43.2 ± 9.1	<5
RERA index (#/h)	14.8 ± 4.6	<10
Sleep efficiency (%)	77.4 ± 2.4	>85
Sleep architecture		
Stage 1 (%)	22.5 ± 5.3	5
Stage 2 (%)	56.2 ± 2.9	45
Stage 3 (%)	6.2 ± 2.0	12
Stage 4 (%)	6.4 ± 4.7	13
REM (%)	8.7 ± 3.7	25

PLM, periodic leg movements; AHI (apnea hypopnea index) = apneas+hypopneas with desaturations >4%; RDI (respiratory disturbance index) = apneas+hypopneas+RERA's per hour; RERA (respiratory event related arousal) = nondesaturating hypopneas per hour; CPAP, continuous positive airway pressure; REM, rapid eye movement.

The mean age for the 10 subjects was 39.40 (SEM = 2.7; range = 27–55). Age was not significantly correlated with any of the Buss–Perry Scales either pre- or posttreatment.

Pretreatment Sleep Study Results

The polysomnography results, body mass index, Beck Depression Inventory-II, and Epworth Sleepiness Scale were not available for three patients because their OSA was diagnosed and treated at other centers, leaving seven subjects for analysis of these parameters. The results are summarized in Table 1. The mean body mass index of 37.2 kg/m^2 placed this group in the obese range (underweight = less than 18.5; normal weight = 18.5–24.9; overweight = 25–29.9; obese = 30 or greater). They scored in the moderately depressed range on the Beck Depression Inventory-II (mean = 20.7). Their mean Epworth Sleepiness Scale score was 13.4, indicating significant daytime sleepiness (possible range 0–24; >10 indicates significant daytime sleepiness, >15 indicates possible pathologic sleep conditions). The mean sleep efficiency was poor at 77.4%, with severely abnormal sleep architecture as seen in Table 1. These results are typical for patients with untreated OSA.

Pearson correlations were performed between the pretreatment results. The Epworth Sleepiness Scale directly correlated to the anger subscale of the Buss–Perry ($r = 0.822$, $p = 0.023$) and to the total Buss–Perry score ($r = 0.896$, $p = 0.006$). The rate of nighttime periodic leg movements was directly correlated to body mass index ($r = 0.766$, $p = 0.045$). The two subjects with intellectual disability had high pretreatment percentages of stage 4 sleep (10% and 33%, respectively) compared with all other subjects (average <1%). As such, their results may have been a confounder in the analysis. When they were included in the analysis, there was an unexpected correlation between increased stage 4 sleep (more restful sleep) and increased verbal aggression subscale scores ($r = 0.804$, $p = 0.029$), which was not present when they were excluded. As well, their exclusion produced a significant relationship between increased REM percentage and the Beck Depression Inventory-II score ($r = 0.944$, $p = 0.016$) which was not significant when they were included ($r = 0.746$, $p = 0.054$).
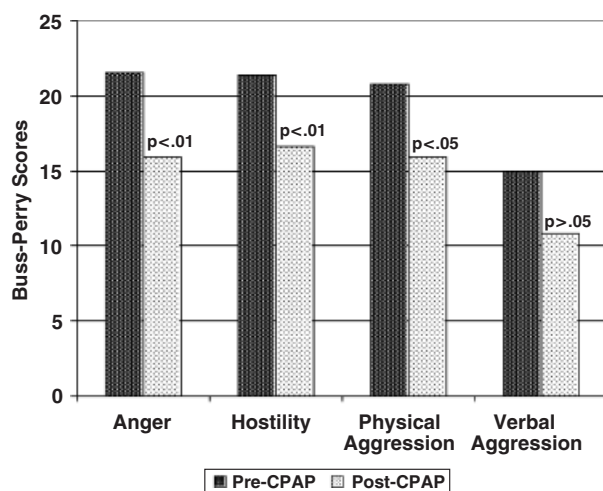
FIG. 1—*Pre-CPAP (continuous positive airway pressure) versus post-CPAP Buss–Perry Aggression scores.*

Increased REM has previously been shown to be associated with major depression (12).

Hostility and Aggression Results

Using paired-sample *t*-tests, the total Buss–Perry score was significantly lower after CPAP treatment (mean = 59.2, SD = 16.6) compared with before treatment (mean = 78.7, SD = 18.9; $t = 3.6$, df = 9, $p = 0.005$). As seen in Fig. 1, the anger subscale dropped from mean 21.5 to 15.9 ($t = 3.3$; df = 9; $p = 0.009$), the verbal aggression subscale dropped from mean 15.0 to 10.8 ($t = 2.1$; df = 9; $p = 0.066$), the hostility subscale dropped from mean 21.4 to 16.6 ($t = 3.4$; df = 9; $p = 0.008$) and the physical aggression subscale dropped from 20.8 to 15.9 ($t = 2.8$, df = 9, $p = 0.021$) (Fig. 1).

Pretreatment parameters were also compared with changes in Buss–Perry scores using Pearson correlations. When the developmentally delayed subjects were included, increased pretreatment stage 4 sleep, which indicates a more normal sleep, was unexpectedly correlated with posttreatment decreases in the verbal aggression subscale ($r = 0.870$, $p = 0.011$), the anger subscale ($r = 0.935$, $p = 0.002$) and the total Buss–Perry score ($r = 0.780$, $p = 0.039$). One would expect more disrupted sleep pretreatment to be associated with larger decreases in these scales posttreatment. When the developmentally delayed subjects were excluded, the stage 4 sleep correlations were no longer significant. Instead, a high pretreatment increase in frequency of Respiratory Event-Related Arousals (which is a hallmark of UARS, the less severe form of OSA), was associated with posttreatment decreases in both the hostility subscale ($r = 0.939$, $p = 0.018$) and the total Buss–Perry score ($r = 0.962$, $p = 0.009$). As well, an increase in pretreatment stage 2 sleep, which is another sign of disrupted sleep, was associated with a decrease in the verbal aggression subscale ($r = 0.882$, $p = 0.048$). Thus, as expected, more disrupted sleep pretreatment was associated with greater decreases in hostility and aggression posttreatment.

The high correlations found in this study were confirmed and appear to be related to the low number of test subjects.

Discussion

This retrospective chart review has demonstrated a decrease in self-reported anger, physical aggression, hostility, and overall aggression among sex offenders following treatment of OSA with CPAP. A similar, but nonstatistically significant reduction was seen in verbal aggression. None of the patients in this study was initially referred due to anger and initial Buss–Perry scores were average. If OSA was contributing to aggression in this group, it is reasonable to hypothesize that even greater effects could occur in patients with higher initial Buss–Perry aggression scores.

It is unclear whether the self-reported reduction in hostility and aggression translates into observable changes in behavior in this patient subset. The mechanism of decreased hostility and aggression is also unclear. It may be that untreated OSA serves as a general factor, which worsens aggressive impulses in vulnerable individuals. For sex offenders, there may be a more direct role on sexual functioning and disinhibition, which may influence their criminal behavior, providing a potential target for therapy and risk reduction. Firestone et al. (13) have recently shown that increased scores on the Buss–Durkee Hostility Inventory (the predecessor of the Buss–Perry Aggression Questionnaire) are significantly correlated with recidivism of both violent and sexual offences by intrafamilial and extrafamilial child molesters. Given the reduction in self-reported aggression demonstrated in the current study, it is hypothesized that CPAP treatment may lead to decreased rates of recidivism in sex offenders with previously untreated OSA.

The lives of sex offenders are often highly disordered (14). They frequently have problems with employment and with social, family, and marital relationships. They also often have comorbid difficulties with substance use, mood disorders, and anxiety disorders. With few exceptions (15,16), the incidence and role of sleep disorders in sex offenders has rarely been discussed. However, the current study shows a potentially important relationship between sleep and aggression, and supports the need for further investigation of sleep disorders and disordered sexual behavior.

This study found that OSA may affect patients with intellectual disability more severely and treatment of OSA in patients with intellectual disability may produce results that are more dramatic. These findings are consistent with the view that sleep deprivation impairs cognitive function. Further investigation into the relationship between intellectual disabilities, effects of sleep deprivation, and aggression will help to explain these associations.

Limitations

These results must be interpreted with caution, due to the limitations of this study. This was a small nonrandomized retrospective chart review of a limited number of patients, without a control group. Other psychopathologies and treatments were not controlled. As well, only a single self-report measure of hostility and aggression was utilized. It is particularly important to recognize that correlation (in this case between changes in scores on a self-report instrument measuring aggression and hostility before and after treatment with CPAP) does not imply causation. Despite these limitations, this study describes a novel explanation and potential treatment of aggression that warrants further evaluation of the link between aggression and OSA.

Conclusions

This is the first study in the literature formally examining the role of OSA in sex offenders. There have been numerous case studies published documenting improvements in aggressive behavior upon treatment of OSA. These improvements would appear to extend to aggression in sex offenders, as evidenced by signif-

icant reductions in hostility and aggression as measured using the Buss–Perry Aggression Questionnaire.

This study provides a basis for further investigations to delineate the interaction between OSA and aggression in sex offenders, and may provide a potential area of treatment.

Acknowledgments

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