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Journal of Psychiatric Research 37 (2003) 313–324

JOURNAL OF  
PSYCHIATRIC  
RESEARCH

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## Human impulsive aggression: a sleep research perspective

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Received 11 October 2002; received in revised form 5 February 2003; accepted 27 February 2003

### Abstract

Impulsive aggression is commonly associated with personality disorders, in particular antisocial and borderline personality disorders as well as with conduct disorder and intermittent explosive disorder. The relationship between impulsive aggression and testosterone is well established in many studies. One of the aims of this study was to characterize the relationship between earlier-mentioned different categorical psychiatric diagnosis describing human impulsive aggression and sleep using polysomnography and spectral power analysis. Another aim was to study the relationship between serum testosterone and sleep in persons with severe aggressive behaviour. Subjects for the study were 16 males charged with highly violent offences and ordered for a pretrial forensic psychiatric examination. The antisocials with borderline personality disorder comorbidity had significantly more awakenings and lower sleep efficiency compared with the subjects with only antisocial personality disorder. The subjects with severe conduct disorder in childhood anamnesis had higher amount of S4 sleep and higher relative theta and delta power in this sleep stage compared with males with only mild or moderate conduct disorder. The same kind of sleep architecture was associated with intermittent explosive disorder. In subgroups with higher serum testosterone levels also the amount of S4 sleep and the relative theta and delta power in this sleep stage were increased. The study gives further support to the growing evidence of brain dysfunction predisposing to severe aggressive behaviour and strengthens the view that there are different subpopulations of individuals with antisocial personality varying in impulsiveness. The differences in impulsiveness are reflected in sleep architecture as well.

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*Keywords:* Human impulsive aggression; Testosterone; Sleep; Polysomnography; Spectral power analysis

### 1. Introduction

Impulsive aggressive behaviour that includes physical aggression directed towards others, self-mutilation, suicide attempts, domestic violence, substance use and property destruction presents a challenge to both research and health care system. The economic and social cost of aggressive behaviour is huge (Scott et al., 2001), and so far both pharmacological and behavioural treatment interventions have been quite ineffective (Malone et al., 2000). As a symptom, impulsive aggression cuts across a number of psychiatric disorders (Moeller, 2001), but it is commonly associated with personality disorders, in particular antisocial (APD)

and borderline (BPD) personality disorders (Eronen et al., 1996; Virkkunen et al., 1996; Goodman and New, 2000; Skodol et al., 2002). In fact, genetic, neurobiological, and diagnostic studies suggest a dimensional approach to BPD symptomatology, with impulsive aggression as one of the core dimensions of the disorder (Goodman and New, 2000; Siever et al., 2002). APD is associated with a pervasive pattern of disregard for and the violation of the rights of others. Not surprisingly, the highest prevalence rates of APD are found in prisons and forensic settings (American Psychiatric Association, 2000). In a study by Fazel and Danesh (2002), 47% of male prisoners had APD. APD often co-occurs with BPD (Coid, 1993; Hudziak, 1996) and it has even been suggested that BPD represents a female form of male-predominant APD (Gunderson and Zanarini, 1987). APD is always preceded by conduct disorder (CD) before the age of 15 (American Psychiatric Association,

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2000). The essential feature of CD is a repetitive and persistent pattern of behaviour in which the basic rights of others or major age-appropriate societal norms or rules are violated (American Psychiatric Association, 2000). Impulsiveness has been found to be the best predictor of conduct problems (Vitacco and Rogers, 2001) and impulsiveness together with emotional lability may increase the likelihood of CD progressing to adult antisocial behaviour (McKay and Halperin, 2001). It has been argued that many individuals with personality disorders display clinically significant impulsive–aggressive behaviour, which cannot be specifically identified using axis II personality disorder diagnosis (Coccaro et al., 1998). In these cases, it would be better to use the diagnosis of intermittent explosive disorder (IED), which may best be regarded as a categorical expression of recurrent, problematic impulsive and aggressive behaviour (Coccaro, 2000). In addition, for research purposes, the diagnosis can also be made for individuals with APD and BPD, in cases where impulsive aggression is of specific clinical relevance (American Psychiatric Association, 2000).

The relationship between testosterone and impulsive aggression has been well established in many studies. High concentrations of testosterone have been shown to be associated with both CD and APD (Virkkunen et al., 1994; Brooks and Reddon, 1996; Stalenheim et al., 1998; Aromäki et al., 2002). In the study by Räsänen et al. (1999), personality-disordered criminals with multiple offences had higher serum testosterone levels than criminal schizophrenics or healthy controls. The role of testosterone in sleep regulation is still fairly unclear, but an association between slow wave sleep (SWS) and serum testosterone in healthy males has been reported (Leibenluft et al., 1997).

Patients with most psychiatric diagnosis have displayed significant changes in sleep parameters (Benca et al., 1992), but less is known about sleep in personality disorders including APD and BPD. In the study by Benson et al. (1990), non-affective BPD patients had less both total sleep and stage 4 sleep (S4). More waking time after sleep onset and reduced rapid eye movement sleep (REM) latency have also been reported (Battaglia et al., 1993). In the study by De La Fuente et al. (2000), BPD patients had less total sleep, longer sleep onset latency and a greater percentage of wakefulness than healthy control subjects. They also had a longer duration of REM sleep, less stage 3 sleep (S3), S4 and SWS, but there was no difference in REM latency. In APD only one sleep EEG study has been reported (Lindberg et al., 2003). In this study habitually violent offenders, all having antisocial personality disorder, had significantly more awakenings during the night and decreased sleep efficiency (SE) but quite contrary to BPD, the amount of both SWS and especially S4 were significantly increased compared with the healthy

controls. In fact, APD appears to be the only psychiatric disorder associated with an increase in deep sleep. Coble et al. (1984) reported that in pre-adolescent boys with CD the number of delta waves during sleep was higher compared with healthy controls. The alcoholic, impulsive violent offenders with IED have been reported to have a profound diurnal activity rhythm disturbance (Virkkunen et al., 1994), but to our knowledge, there are no sleep EEG studies in this diagnosis group.

Greater understanding of subgroups within the broad category of persons with impulsive aggression may help to create more effective treatment interventions (Hill, 2003).

Polysomnography may provide additional information in sub-typing persons with severe aggression problems. One aim of the study was to characterize the relationship between different categorical psychiatric diagnosis describing impulsive aggression and sleep using polysomnography and spectral power analysis. Another aim was to study the relationship between serum testosterone and sleep in persons with severe impulsive aggression.

## 2. Material and methods

### 2.1. Subjects

The subjects for the study were 16 males with a history of recurrent violent acts. They were charged with violent offences and ordered for a pretrial forensic psychiatric evaluation lasting approximately two months by the Finnish National Board of Medico-Legal Affairs. The evaluation took place in a special ward of a university psychiatric hospital. Diagnoses were made by the same senior forensic psychiatrist (H.N.) using structured clinical interview SCID I and II (First et al., 1997a, First et al., 1997b). All 16 males met the DSM IV criteria for APD, and in addition six of them also for BPD (American Psychiatric Association, 1994). Subjects with a DSM-IV axis I diagnosis other than drug and alcohol dependence were excluded, as were subjects with an axis II diagnosis other than the two earlier-mentioned personality disorders. The trial records and all available background information, including medical, family, school and criminal history from childhood and adolescence to adulthood, were studied. Using these data and information from SCID-interviews, the severity of the preceding CD and the possible diagnosis of IED were evaluated. The severity of the preceding CD was rated as mild (lying, truancy, staying out dark without permission), moderate (stealing without confronting a victim, vandalism) or severe (forced sex, physical cruelty, use of a weapon, stealing while confronting a victim, breaking and entering) using the descriptive guidelines of DSM-IV-R (American Psychia-

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