

EEG correlates of moderate intermittent explosive disorder

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Accepted 30 September 2007

Available online 26 November 2007

Abstract

Objective: We investigated electroencephalographic (EEG) correlates of moderate intermittent explosive disorder (mIED), which is characterized by uncontrollable, impulsive attacks that either manifest in aggressive outbursts of temper, or in impulsive, auto-aggressive behaviour.

Methods: In two Experiments, EEG data were recorded during rest conditions, and while subjects were presented with auditory and visual stimuli. Additionally, scores of the I₇ impulsivity scale (designed to capture acting on impulse) were obtained.

Results: In Experiment 1, individuals with mIED showed a stronger increase in the power of oscillatory activity in the beta band, along with a stronger power decrease in the theta band in response to both visual and auditory stimuli. Based on discriminant function analysis, a model of discriminant functions was derived that clearly separated the mIED group from the control group. In Experiment 2, subjects were categorized into either of two groups (supposedly without mIED, with mIED) based on this model of discriminant functions. Results showed that I₇ impulsivity scores clearly differed between groups.

Conclusions: The present data show a relation between oscillatory brain activity and mIED. They indicate that this brain activity is related to the impulsivity facet of impulsive action, and suggest that mIED can be assessed based on the analysis of electrophysiological data.

Significance: To our knowledge, this is the first study on EEG correlates of (m)IED. Results open up new perspectives for future investigations on disorders characterized by substantial impulsivity.

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Keywords: Intermittent explosive disorder; Impulsivity; Aggression; EEG; Beta activity

1. Introduction

Intermittent explosive disorder (IED), as defined in DSM-IV, is a disorder characterized by discrete episodes of aggressive impulses that result in serious assaultive acts or destruction of property. The degree of aggression expressed during an episode is grossly out of proportion to any precipitating psychosocial stressors, and the explosive episodes are not better accounted for by another mental disorder or due to the direct physiologic effects of a

substance or a general medical condition (for overviews see McElroy, 1990; Olvera, 2002). It is assumed that IED is probably more common than realized and may be an important cause of violent behaviour (e.g., McElroy, 1990; Coccaro et al., 1998; Kessler et al., 2006; Coccaro et al., 2005). Moderate forms of IED (here referred to as mIED) are usually not diagnosed, possibly due to the lack of appropriate diagnostic instruments (see also Coccaro et al., 1998).

Similar to IED, individuals with mIED typically produce impulsive outbursts of temper which are out of proportion to a precipitating event. In contrast to IED, however, individuals with mIED act less intensely during an episode, and in a fashion which is usually socially tolerated (e.g., slamming doors, smashing dishes or loud angry

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shouting during rage attacks). These outbursts often have a disadvantageous impact on individuals, their families, and their occupational career. Individuals with mIED typically report that they cannot control these attacks, and that they view the actions performed during these episodes as alien, often embarrassing, and distasteful. They regret violent acts performed during their outburst immediately after the attack is over, although they agree that this regret does not help to avert such episodes in the future. In contrast to IED, which is considered exclusively as an aggression disorder, some individuals with mIED may not show aggressive outbursts, but rather impulsive, auto-aggressive behaviour (such as strong inner rage, or in extreme cases self-injuring behaviour). Impulsive aggression (whether explosive or impulsive) is, thus, also an important aspect of this phenomenon (see also Siebel, 1994).

Literature on neurophysiological correlates of (m)IED is relatively scant. A number of studies have reported reduced serotonin levels in personality disordered individuals with IED (for an overview see Olvera, 2002), and previous literature has linked the abrupt outbursts typical for individuals with (m)IED to an accumulation of stress hormones which are suddenly released when serotonin levels are low (this phenomenology was described as a ‘‘Cerebro-Physiological Switch’’; Siebel, 1994; Siebel and Winkler, 1996). Electrophysiological correlates of (m)IED have, to our knowledge, not been reported so far.

2. Experiment 1

In Experiment 1, we examined oscillatory brain activity in individuals with and without mIED. Participants’ EEGs were measured during rest conditions, as well as during the presentation of auditory, and visual stimuli (an excerpt from the first movement of Beethoven’s 5th symphony, and sentences describing mIED). These stimuli were chosen to agitate the mIED subjects, with the idea that this agitation leads to mIED-specific alterations of oscillatory brain activity which can be detected using spectral analysis of the EEG.

Regarding the hypotheses, no previous (m)IED study has been available to predict specific effects. However, possible effects could be expected based on investigations of children with attention deficit/hyperactivity disorder (AD/HD). Clarke et al. (2001a) reported that a subgroup of AD/HD children with increased temper tantrums had increased relative beta, along with decreased relative alpha, and a decreased theta/beta ratio (for an overview see also Barry et al., 2003). Similar findings were reported in another study from Clarke et al. (2001b), in which a group with excessive beta showed less absolute theta and less relative theta power than a typical AD/HD group. Again, this group was more prone to temper tantrums and mood swings. The increased beta, and decreased theta as well as alpha power values in these impulsive groups had been linked to cortical hyperarousal (Clarke et al., 2001a,b), and the results of these

studies suggest that elevated beta activity (and decreased theta as well as alpha activity) might be indicative for increased impulsiveness (particularly with regard to the impulsivity facet impulsive action/behavioural disinhibition), probably also in individuals without AD/HD. Consistent with these findings, Houston and Stanford (2005) reported lower delta and theta activity in a non-clinical group scoring high on the Barratt Impulsiveness Scale (BIS-11).

Based on these studies, we hypothesized that alterations in the spectral power of the EEG during the presentation of auditory and visual stimuli compared to the rest conditions would differ between individuals with and without mIED. We analyzed power values in theta, alpha, and beta frequency bands, and tested possible differences between groups in each of the three frequency bands. According to the mentioned results from Clarke et al. (2001a,b), increased beta activity, along with decreased theta and alpha activity, was to be expected.

In addition to the EEG measurements, we obtained scores of the impulsivity scale of the I₇ impulsivity questionnaire (Eysenck et al., 1990) from each subject. This scale captures acting on impulse, sometimes despite the probability for negative consequences. Because mIED is also characterized by impulsive actions that often have disadvantageous outcomes, it was hypothesized that subjects with mIED score higher on the I₇ impulsivity scale than subjects without mIED.

2.1. Methods

2.1.1. Participants

Fifty-four subjects were included in the study, 28 without mIED (mean age = 26;7 years, range 18–55 years; 14 females), and 26 with mIED (mean age = 28;4 years, range 18–54 years; 14 females). Subjects did not take medication, and were reported to have normal hearing and normal (or corrected to normal) vision.

2.1.2. Participant selection

Subjects underwent an unstructured narrative interview in which they were asked about experiences typical for mIED: They were asked whether they sometimes produce outbursts of temper, and – if so – whether these outbursts are often in excess of what other individuals might consider as appropriate with respect to the precipitating event. Furthermore, they were asked if they are able to control these attacks, and if they regret violent acts performed during an outburst immediately after the attack is over. They were also asked if they viewed the actions performed during these episodes as foreign and distasteful, and if they agreed that such regret had not been helpful in averting such episodes. As mentioned in the Introduction, some individuals with mIED may show autoaggressive attacks, rather than outbursts. Thus, subjects were also asked if they frequently had experiences of inner rage in which they direct their aggression inwards, rather than outwards. Typically, such

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