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Short communication

Overnight urinary cortisol release in women with borderline personality disorder depends on comorbid PTSD and depressive psychopathology

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Abstract

Free cortisol was investigated in BPD patients and healthy controls. A positive association was found between cortisol and depression scores, while the number of PTSD symptoms was negatively correlated with cortisol release. These findings suggest that alterations in cortisol release in BPD are strongly associated with the severity of psychopathology.

Keywords: Borderline personality disorder; PTSD; Cortisol; HPA axis; Childhood trauma

1. Introduction

Alterations of the hypothalamus–pituitary–adrenal (HPA) axis have been found in different psychiatric disorders and there is evidence for an association with early adverse life experiences [1,26]. Early life stress results in an increased risk for the development of mood and anxiety disorders [9–11,17]. Posttraumatic stress disorder (PTSD), and major depression disorder (MDD) occur frequently in patients with borderline personality disorder (BPD) [7,18,28]. While there is evidence for an enhanced central release of corticotropin releasing factor in patients suffering from PTSD or MDD [2,20], basal cortisol levels as well as feedback regulation differ between these disorders [19,26].

Only a few studies of BPD have evaluated HPA axis function yielding varying results [3,12,13,15,23]. These diverging results may be due to different prevalence rates of comorbid psychiatric disorders like PTSD and/or MDD in the BPD samples [14,21,26]. Surprisingly, only a few studies have investigated basal cortisol release in BPD. One study reported increased free cortisol on awakening and higher total daily cortisol [15]. Another investigated 24 h urine cortisol release in PTSD patients with and without comorbid BPD [24]. The authors found higher cortisol in patients with just PTSD in comparison to the BPD group, which may partially explain divergent findings in PTSD literature.

The aim of this study was to further evaluate unstimulated free cortisol excretion in patients with BPD and its association with other clinical features.

2. Method

2.1. Subjects

We recruited 21 female patients with BPD and 24 healthy female controls. There were no differences in age (mean [SD]: patients 28.1 [5.4], controls 27.7 [6.9]) or body mass index (patients 24.4 [5.8], controls 24.1 [5.1]). No participants were pregnant or suffered from significant physical illness.

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Additional exclusion criteria were anorexia, schizophrenia, schizoaffective disorder, major depressive disorder with psychotic symptoms, alcohol and/or drug dependence. All subjects were drug free for at least 7 days before endocrine assessments. All participants gave their written informed consent. The study was approved by the institutional review board (Ethics Commission of the Medical University of Luebeck).

2.2. Clinical assessment

All participants were evaluated for BPD using the Structured Clinical Interview for DSM-IV Personality Disorders (SCID-II) and for PTSD using the SCID-I [25]. Severity of PTSD was estimated by the number of symptoms reported. Depressive mood state was measured using Beck Depression Inventory (BDI) [4]. Trauma history was assessed using Childhood Trauma Questionnaire (CTQ) [5].

2.3. Cortisol assessment

Urine was collected over three consecutive nights (7 p.m. to 7 a.m.). Urinary free cortisol concentrations (μg/12 h) were assayed by radio-immunoassay (RIA, Immunotech). Inter-assay coefficient of variation was 5.4–9.2% and intra-assay coefficient of variation was 3.5–5.1%.

2.4. Statistical analyses

Demographic and clinical data were analyzed using *t*-test or one-way analysis of variances. Mean cortisol was computed from measurements on three consecutive nights because of potential intra-individual variation of hormonal release and analysis of covariances was also applied. Partial correlations were performed to test associations between clinical and endocrine data.

3. Results

Patients reported a significantly more severe childhood trauma history (CTQ) and reached higher mean depression (BDI) compared to controls (Table 1). Sixteen (76.2%) patients suffered concurrently from PTSD.

In the patient group partial correlations between cortisol release and clinical variables were performed. When controlling for depression (BDI score), the number of PTSD symptoms was significantly negatively associated with mean 12 h cortisol ($r = -0.637$, $p = 0.003$). There were significant partial correlations between cortisol and the symptom clusters re-experience ($r = 0.688$, $p = 0.001$) and avoidance ($r = -0.520$, $p = 0.019$), but only a trend for an association with arousal ($r = -0.429$, $p = 0.059$). BDI scores showed a significant positive correlation with cortisol ($r = 0.352$, $p = 0.019$), when controlling for the number of PTSD symptoms. Number of PTSD symptoms did not correlate with BDI scores ($r = 0.272$, $p = 0.233$).

When statistically controlling for CTQ and BDI scores (one-way ANCOVA) patients with BPD showed higher mean cortisol release in comparison with controls (Table 1). CTQ scores were used as covariate, as PTSD symptoms were only assessed in patients because the controls had suffered no trauma experiences.

To evaluate the impact of PTSD symptoms on endocrine alterations the BPD group was divided by median-split (median = 9) into subgroups with low and high numbers of PTSD symptoms. These subgroups significantly differed with respect to the number of reported PTSD symptoms ($t_{df:19} = -5.303$, $p = 0.001$) but not with respect to depressive symptoms. When compared with the controls, only the subgroup with a low number of PTSD symptoms showed a higher level of cortisol release ($F_{df:2,42} = 4.62$, $p = 0.021$, Fig. 1).

Depressive symptoms were controlled because of their impact on HPA axis function. The patients were divided into subjects with high and low BDI scores by median-split (median = 25). No difference was found between these subgroups with respect to their cortisol levels ($t_{df:19} = -0.18$, $p = 0.863$).

Table 1
Sample characteristics and mean 12 h urinary cortisol in BPD patients and controls[a]

	BPD Group ($N = 21$)	Control group ($N = 24$)	Statistics
BDI	29.7 (12.5)	3.0 (3.6)	$t_{df:43} = 9.98$, $p < 0.001$
Number of PTSD symptoms	9.14 (3.5) (min: 0, max: 15)	–	–
CTQ total[b]	11.9 (3.2)	5.6 (0.7)	$t_{df:43} = 9.48$, $p = 0.001$
Physical abuse	3.3 (0.8)	1.4 (0.3)	$t_{df:43} = 9.42$, $p = 0.001$
Emotional neglect	3.5 (0.6)	2.0 (0.4)	$t_{df:43} = 9.01$, $p = 0.001$
Physical neglect	2.3 (0.7)	1.1 (0.2)	$t_{df:43} = 7.69$, $p = 0.001$
Sexual abuse	2.9 (1.4)	1.0 (0.1)	$t_{df:43} = 6.60$, $p = 0.001$
Mean urinary cortisol (μg/12 h)			
Observed means	14.39 (14.1)	10.29 (4.3)	
Estimated means corrected for CTQ and BDI	19.79 (3.8)	5.44 (3.4)	$F_{df:1,412} = 4.55$, $p = 0.039$

[a] Data are given as mean (SD).
[b] Weighted scores are given.

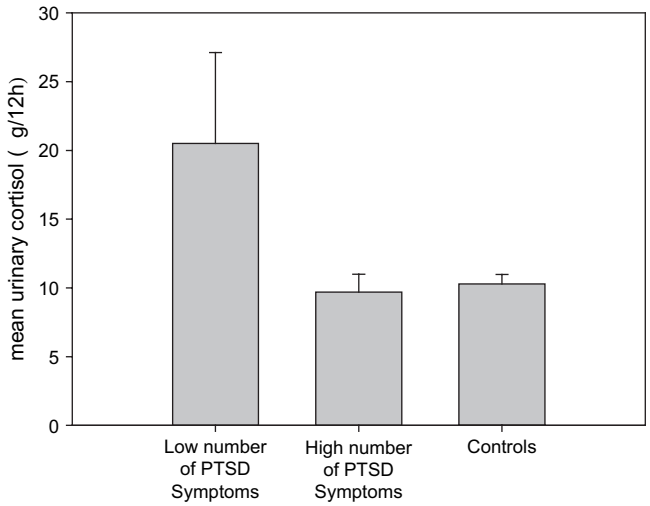

Fig. 1. Mean (SE) over night urinary cortisol release in BPD patients with high ($N = 9$) and low ($N = 12$) number of PTSD symptoms compared to healthy controls ($N = 24$) ($F_{df:2,42} = 4.62$, $p = 0.021$).

4. Discussion

This first investigation of overnight urinary free cortisol in patients with BPD compared to controls showed higher cortisol levels in patients with BPD. There was a negative association between cortisol and PTSD symptoms. When dividing the BDP group in patients with a high or low number of PTSD symptoms, exaggerated cortisol levels were only found in BPD patients with a low number of PTSD symptoms.

Consistent with these results, Lieb and colleagues reported enhanced free cortisol in saliva collected over the day in BPD [15]. They also found reduced feedback sensitivity in response to 0.5 mg dexamethasone. Comorbid PTSD was not assessed. Non-suppression in the DST was previously only found in BPD patients without comorbid PTSD, while BPD patients with PTSD were comparable to controls [14].

For PTSD there are several studies on 24 h urinary cortisol yielding mixed results (see Refs. [26,27]), while only few studies evaluated overnight cortisol release [6,16,22]. In one study 12 h urinary cortisol was measured in mothers of child cancer survivors with and without PTSD [8]. Exaggerated cortisol was only found in the non-PTSD group compared to controls. Another study found no differences in over night urinary cortisol in PTSD patients and controls [22]. Both results agree with those of this study. Higher 24 h urinary cortisol levels have been found in patients with PTSD compared to patients with PTSD and comorbid BPD [24]. It was suggested that these differences might reflect differences in the severity of PTSD symptoms rather than factors related to BPD per se [24]. Unfortunately, this study did not use controls, making it difficult to compare with the present data. Furthermore, 24 h and 12 h urinary cortisol measurements are not comparable, due to the circadian rhythm of cortisol release.

In sum, the data presented here further support the hypothesis of the relevance of comorbid PTSD symptoms in BPD for HPA axis alterations.

Despite the significant positive partial correlation between depression score and cortisol release there were no group differences between patients with high and low BDI scores. The PTSD effect may be the stronger one, which is indicated by the high negative correlation between re-experience symptoms and cortisol. Another point is the lack of an association between PTSD symptoms and BDI scores, possibly caused by an equal distribution of patients with low or high PTSD symptoms in the two ‘‘depression subgroups’’. Noteworthy, Rinne et al. showed comparable cortisol levels after DEX in BPD patients with PTSD and patients with PTSD + MDD, while the BPD + MDD group differed significantly from the BPD + PTSD group [21].

4.1. Limitations

Depressive symptoms were measured with a self-rating scale and MDD was not evaluated by a structured interview. Furthermore, no standardized PTSD rating scale was used. Another limitation was the small sample size, especially for the subgroup analyses. Furthermore, only women were studied, making comparison with other studies difficult [24]. Unfortunately, there were no controls for menstrual cycle phase or oral contraceptive intake although they are known to influence HPA axis outcomes. Time of awakening could not be evaluated and therefore possible interfering effects could not be excluded. A more general problem is that measurement of childhood trauma with the CTQ is only retrospective. However, most studies in this field use such retrospective questionnaires.

In sum, there is evidence for HPA axis hyperactivity in BPD, e.g. enhanced cortisol excretion and reduced feedback sensitivity [14,15]. These alterations seem to be mediated by trauma-related symptoms and depressive psychopathology. Further studies are needed, evaluating comorbidity-related subgroups.

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