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Rapid eye movement sleep in adolescent females with borderline personality disorder

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Abstract---Objective: The aim of the study was detecting Rapid Eye Movement (REM) sleep abnormalities in adolescent females with borderline personality disorder (BPD). Method: A case control study included a convenient sample of 30 adolescent females with BPD compared to 30 matched healthy controls. Pittsburgh Sleep Quality Index and an overnight sleep lab polysomnographic study were applied to both groups to assess sleep. Results: Patients with BPD were subjectively dissatisfied with the quality of sleep compared to controls ($p < 0.001$). Abnormalities in REM sleep in patients when compared to controls were higher REM percent ($p = 0.001$), shorter REM latency ($p = 0.001$), higher REM density ($p = 0.001$) and higher number of REM periods in the first half of the night ($p = 0.000$). Conclusion: REM sleep

abnormalities are found in adolescent patients with BPD, which may be considered as trait markers for BPD.

Keywords---adolescent, borderline personality, polysomnographic, REM sleep, females.

Introduction

REM sleep and emotions are neurobiologically linked (Walker, 2009). During this sleep stage, the emotional memories are processed into the existing memory networks (Walker and Stickgold, 2010). Studies have shown that REM rich sleep facilitates affectively negative memories relative to neutral memories suggesting that REM sleep can selectively foster the consolidation of emotional stimuli (Wagner et al., 2001).

Borderline Personality Disorder (BPD) is often identifiable at a young age, and sometimes appear early in adolescence (Bradley et al., 2005). The disorder is characterized by fluctuations between periods of self-confidence and times of absolute despair, markedly unstable self-image, rapid changes in mood, with fears of abandonment and rejection, and a strong tendency towards suicidal thinking and self-harm (Links et al., 1989). Prevalence of sleep related problems in adult with BPD has been reported to range from 15% to 95.5%, including disturbances of sleep continuity, altered REM sleep regulation and nightmares (Asaad et al., 2002; Plante et al., 2009).

Borderline Personality Disorder was viewed as lying on the same continuum with trauma and stress related disorders and mood disorders, thus are postulated to share a common neurobiological predisposition and psychopathological formulation with these disorders (Cattane et al., 2017).

Most of the studies found that short REM sleep latency, longer REM duration, and higher REM density was found in both major depression, and adult borderline personality patients even in absence of depression (Hafizi, 2013).

Explanation of REM sleep abnormalities in the previously mentioned disorders could be understood in terms of linked etiology and pathophysiology where genetic factors are involved in the development of sleep changes through complex neurobiological processes involving noradrenergic, serotonergic, cholinergic and orexinergic neurotransmitter systems which regulate sleep. Others interpret REM sleep changes as mere consequences of the neurobiological processes underlying these disorders or simply a sign of inefficient REM sleep processing of affectively toned stimuli (Palagini et al., 2013; Hafizi, 2013).

It is hypothesized that REM sleep abnormalities could be detected in adolescents suffering from BPD, as adolescence period may represent a temporal window of vulnerability for BPD. This study aimed at detecting these abnormalities particularly in REM stage (REM percentage, number of REM periods, REM latency, REM density, and REM distribution) in adolescent females with BPD.

Method

The study was an observational, analytic, case-control study conducted in the period from April 2017 to December 2017.

The study included sixty adolescent females in two groups. Sample size calculation was done using G* power software version 3.1.9.2. An effect size of 0.75 was detected from a previous study investigating sleep in adult patients with BPD (Assad et al., 2002). The patient group included a convenient sample of 30 adolescent (13 to 19 years old) females with BPD recruited from Adolescent Psychiatry outpatient clinic, Psychiatry and Addiction Prevention Hospital. The clinic is held twice weekly. The study focused on female subjects as there were few male subjects with BPD presenting to our facility. All patients fulfilled the DSM-IV TR diagnostic criteria of borderline personality disorder (APA, 2000).

Participants with a comorbid DSM-IV axis I disorder including psychotic disorders, mood disorders, substance use disorders and/or a comorbid sleep disorder were all excluded. Other exclusion criteria included subjects receiving psychotropic medications or any drugs known to affect sleep in a period of 2 weeks prior to participation in the study.

Fifty-seven female adolescents with BPD were initially selected and interviewed, 11 patients were excluded due to a comorbid mental disorder or substance use disorder, 8 patients were excluded because they were on mood stabilizers and/or antipsychotics, 6 patients withdrew their consent prior to PSG, 2 patients were not able to sleep in the sleep lab.

The control group subjects were 30 healthy (no psychiatric/medical disorders nor psychotropic or other medication use) female adolescents who were matched to patients as regard age and gender. They were recruited through an advertisement made in the same hospital inviting subjects to participate and receive a monetary incentive.

Participants were assessed using the following tools:

- 1- *The Structured Clinical Interviews for DSM-IV Disorders (SCID- I & II)* (First et al., 2002), *Arabic version* (Hatata et al., 2004): SCID-I & II are structured clinical interviews which provide an assessment of the DSM-IV listed mental disorders and personality disorders. They are valid and reliable instrument (Drill et al., 2015) which were used in the present study to confirm the diagnosis of BPD in patients and to rule out comorbid psychiatric disorders including mood disorders in patient and control groups.
- 2- *The Borderline Personality Questionnaire (BPQ)* (Poreh et al., 2006): The BPQ was developed for assessment of the core features of the borderline personality disorder. It is a self-report made up of 80 statements with dichotomous response format (True/False). It includes subscales measuring impulsiveness, affective Instability, abandonment, relationship, self-image, suicide/self-Mutilation, emptiness, intense anger, and quasi-psychotic states. The instrument has shown adequate levels of sensitivity and specificity and has been specifically accredited for use in the detection of BPD in young population (Glenn and

Klonsky, 2013). Higher scores denote more severe personality disorder and impairment. It was applied on patient group only.

3-Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989): The PSQI is a self-report questionnaire that assesses sleep quality over a 1-month time interval. It consists of 19 individual items generating seven “component” scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each scale ranges from 0 “no difficulty” to 3 “severe difficulty”. The sum of these components yields a Global Sleep Quality score ranging from 0 to 21, with high scores indicating poor sleep quality and scores less than five indicating good sleep quality. The questionnaire has been used in research and clinical settings and has been used in the diagnosis of sleep disorders. It has been translated into Arabic (Suleiman et al., 2010) and tested in a sample of Arabic bilinguals (de la Vega et al., 2015; Passos et al., 2017).

4-Overnight Polysomnographic Study:

An overnight sleep technician attended polysomnography was done for all participants using Compumedics Profusion PSG 3.2 in the sleep lab of Psychiatry and Addiction Prevention Hospital, Faculty of Medicine, Cairo University. The electrodes were placed according to the American Academy of Sleep Medicine (AASM version 2.2) recommendations for electrode placement and filter settings. The electroencephalogram (EEG) included frontal, central, and occipital electrodes (referenced to M1 and M2), electrooculography (EOG) activity, submental electromyogram (EMG) activity, ECG activity, airflow, respiratory effort, and oximetry. Bio-calibration was done to check for the correct placements and corresponding recordings of parameters. The participants were taken to recording room 1 hour prior to their habitual sleep timings and were left to wake up spontaneously after at least 6 hours of recording. The recording times ranged from 11 P.M. to 8 A.M. (weekend nights) and school nights were avoided.

Automatic scoring of sleep stages and other events was done and subsequently validated by manual scoring by an associate professor of Clinical Neurophysiology who was blinded to the diagnosis of the participants in a 30-second epoch (sleep staging) or a 5-minute epoch (respiratory events and limb movements) according to guidelines of AASM scoring manual version 2.2 (Berry et al., 2015).

Sleep architecture measures included: Total Recording Time (TRT), Total Sleep Time (TST), sleep onset latency, sleep efficiency ($TRT/TST \times 100$), percentages of N1, N2, N3 and REM sleep stages, REM onset latency, number of awakenings, arousal index (total number of arousals/hour sleep). The neurophysiologist computed the following variables manually; first REM period density, total REM density, number of REM periods in the first half of the night and the second half of the night.

REM density was measured by dividing number of rapid eye movement “conjugate, irregular sharply peaked eye movement with an initial deflection usually lasting less than 500 ms” according to AASM scoring manual version 2.2 on REM period duration in minutes (Wichniak et al., 2002).

Data Analysis: Patients’ data was coded and secured in a personal computer with no access except for researchers. Data was analyzed using the statistical package

SPSS version 20 (IBM, 2011). Data was summarized using mean and standard deviation in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using Mann-Whitney test. For comparing categorical data, Chi square (χ^2) test was performed. Correlations were done using Spearman correlation coefficient. P-values less than 0.05 were considered statistically significant.

Results

The mean age of the patient's group was 16.97 ± 1.83 while, the mean age of the control group was 17.47 ± 1.72 with no statistical difference between the 2 groups ($p=0.307$) (table 1). Other demographic and personal data including education, occupation, marital status, family history and Body Mass Index (BMI) is outlined in table 1.

Regarding borderline personality character traits, clinical examination showed that all the patients presented with emotional dysregulation, 46.7 % with difficulties in interpersonal relations, 31.7 % of them presented with cognitive distortions, and 28.3 % with impulse control problems. 76.7 % of patients complained of frequent nightmares. Table (1) outlines the means and SD of the BPQ subscales including impulsivity, affective instability, abandonment, relationships, self-image, suicide/self-harm, emptiness, intense anger, quasi-psychotic symptoms and the total score.

Regarding Pittsburgh Sleep Quality Index (PSQI), patients showed mean score of 11.60 ± 4.005 while control group showed mean score of 3.53 ± 1.66 with statistically significant differences between both groups ($p<0.001$) which denotes that patients were less satisfied and had more complaints regarding their sleep quality (table 1).

In the overnight sleep study, TST mean and SD duration in patient group was 359.22 ± 64.59 minutes compared to 327.50 ± 62.71 in the control group with statistically significant difference between the 2 groups ($p=0.036$) (table 1). REM percentage from TST mean and SD was 18.96 ± 6.83 in the patient group compared to 12.79 ± 4.97 % in the control group ($p < 0.001$). REM latency mean and SD in patients was 85.68 ± 30.42 minutes compared to 212.55 ± 60.70 in the control group ($p<0.001$) (table 1 and figure 1). Total REM density was higher in the patient group with mean density of 7.76 ± 4.16 and 4.23 ± 2.90 in the control group ($p < 0.001$) (table 1 and figure 2). Moreover, number of REM periods in the first half of night in the patient group was 2.03 ± 0.89 compared to 0.43 ± 0.57 in the control group with statistically significant difference between the 2 groups ($p < 0.001$) (table 1 and figure 1).

Figure 1-a

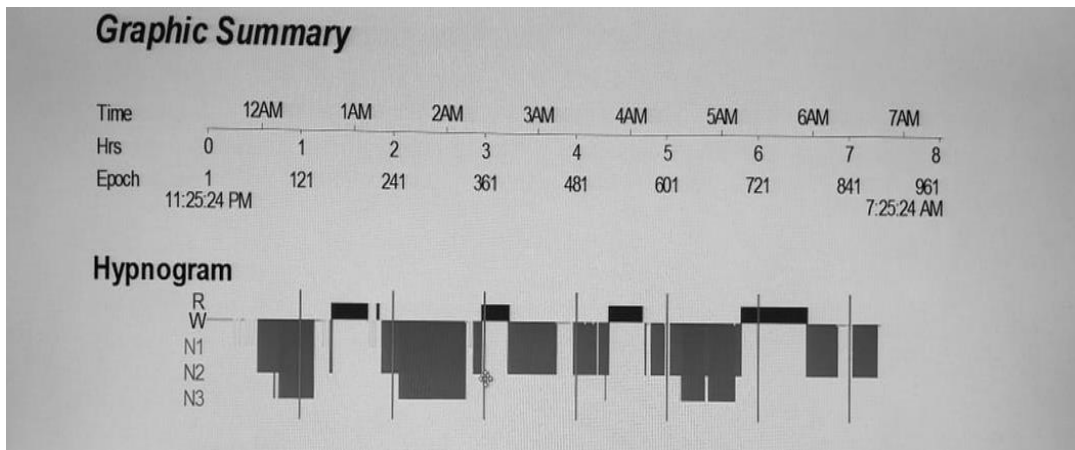


Figure 1-b

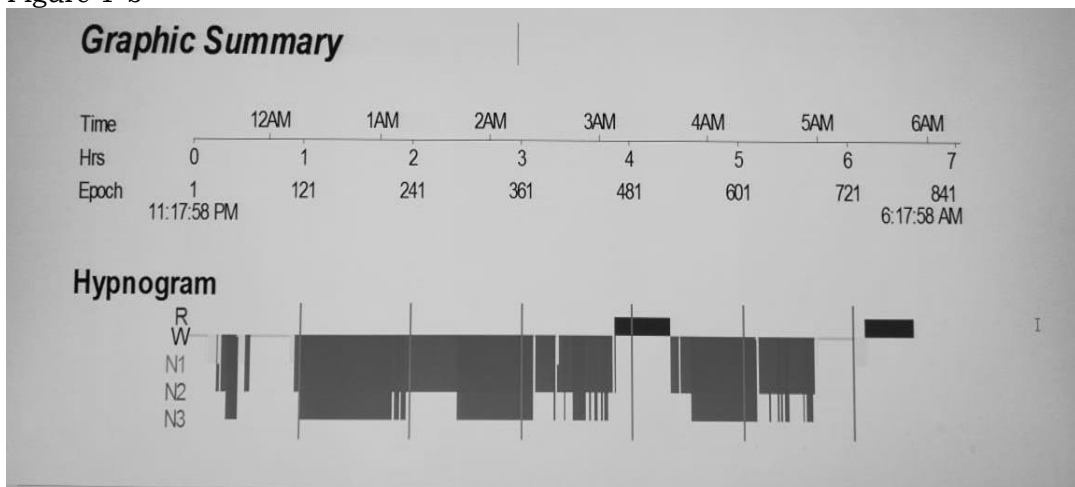


Figure (1): Showing the hypnogram of one of the patients above (1-a) and the hypnogram of one of the controls below (1-b). Note the relatively shorter REM onset latency and tendency of REM periods to occur in the 1st half of the night in the patient compared to the control.

Total REM percentage from TST, REM latency, first REM duration, total REM density and first REM density did not correlate significantly with any of BPQ sub scores or total score. Number of REM in the first half of the night showed significantly negative correlation with abandonment, relationship and BPQ total score ($P=0.03$, 0.03 and 0.05 respectively) (table 2).

Figure 2 a

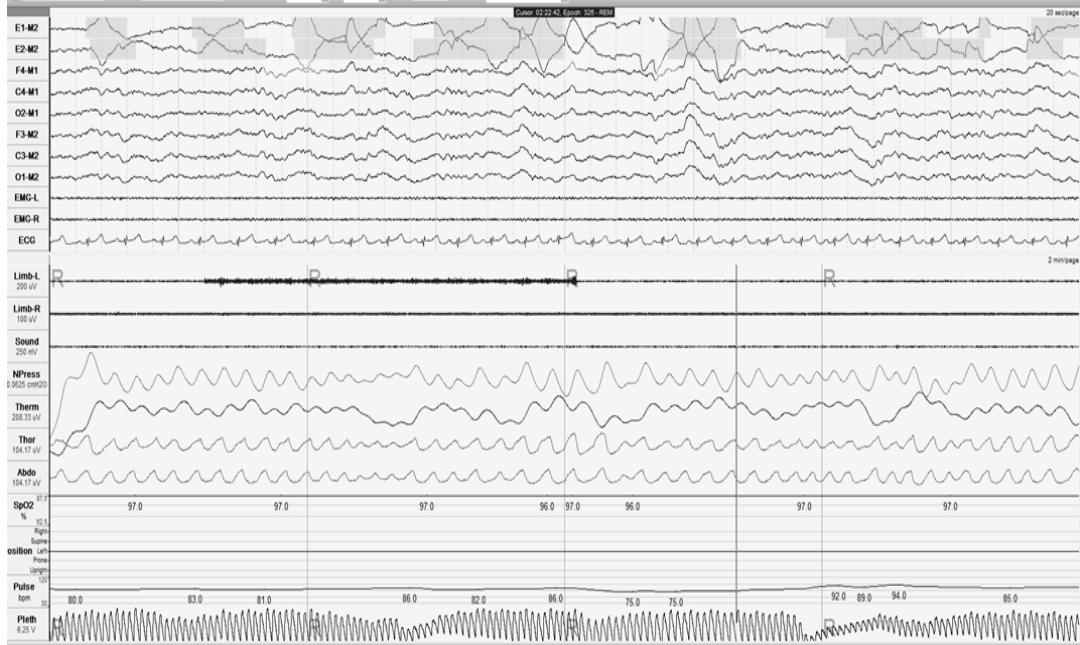


Figure 2-b

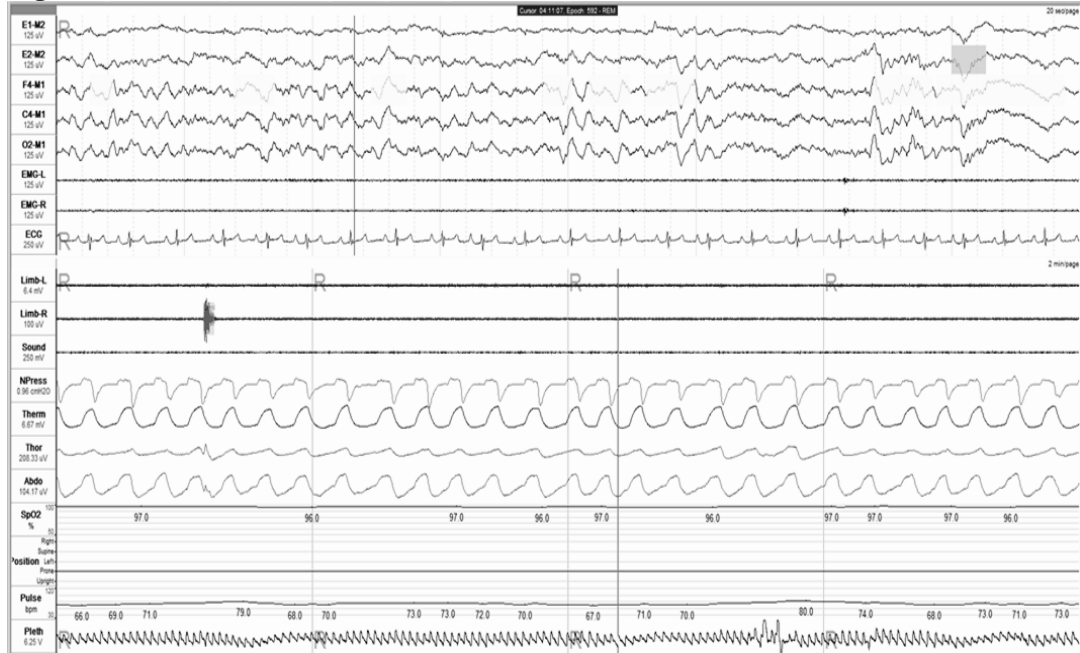


Figure (2): a 20 s epoch of REM sleep of a patient above (2-a) compared to a control subject below. Note the higher REM density in the patient compared to control (2-b).

Discussion

Abnormalities in REM sleep detected in the current study are consistent with the results of previous studies done in adult patients with BPD (Hafizi, 2013). However, the current study implies that these findings are present since adolescence, before the maturation of the personality, suggesting their potential role as a trait marker for BPD.

Previous studies conducted on adolescents with BPD using actigraphy have demonstrated persistent disruption in sleep-wake patterns in these patients, however details of these findings could be better elaborated using polysomnography (Guile et al., 2009; Huynh et al., 2016).

In the current study, the PSQI showed that BPD adolescent patients have rated their total sleep quality significantly worse than the controls, even though no significant differences in sleep efficiency, arousal index, number of awakenings and slow wave sleep percentage were observed. Possible explanations include sleep-state misperception that is associated with BPD, impact of frequent nightmares (76.7 % of patients) and REM sleep dysregulation that was detected in these patients. This finding is in line with the studies that showed that patients with BPD report subjective dissatisfaction with their sleep quality despite demonstrating similar sleep patterns to controls (Bastien et al., 2008; Philipsen et al., 2005).

Unexpectedly, the TST was higher in BPD patients than controls, despite comparable recording time and sleep efficiency. It is proposed that the first night effect was more pronounced on controls than patients, being volunteers and not seeking treatment in the medical facility.

Reduced REM onset latency [values range in adolescents between 45-329 minutes with mean value of 137 min (Mason et al., 2008)], increased REM percentage and higher REM density detected in this study are in concordance with previous findings in adults where some studies have attributed short REM onset latency to the presence of mood symptoms. Meanwhile, other studies proposed that BPD disorder can be viewed as a mood spectrum related disorder. The current study doesn't attribute these abnormalities to comorbid mood symptoms as they were demonstrated in young, non-depressed patients (Asaad et al., 2002; Battaglia et al.; 1993, De la Fuente et al.; 2004, Philipsen et al., 2005). Moreover, the current study showed increased REM periods in the first half of the night in these patients, a finding that was supported by previous studies (Oltmanns et al., 2014; Winsper et al., 2015).

The higher REM density detected in this study was also detected in patients suffering from PTSD (Kobayashi et al., 2007). A model of REM dependent consolidation of learned fear in the early stages after trauma was recently proposed in these patients (Murkar and De Koninck, 2018). Research has repeatedly shown that emotionally traumatic events are likely to be experienced by patients with BPD in their childhood (Cattane et al., 2017). These REM abnormalities might be considered as common vulnerability markers to both disorders. In addition, a retrospective cohort study conducted on adolescents has

shown that persistent nightmares in childhood were strongly associated with BPD symptoms in early adolescence (Lereya et al., 2017).

Baglioni and colleagues (2016) conducted a meta-analysis to investigate the polysomnographic sleep changes in several mental disorders and to identify both transdiagnostic and disorder-specific sleep alterations. They found that no two conditions had the same sleep profile. They suggested that REM sleep variables may be associated with neurobiological pathways underlying alterations of cognitive and emotional processes, thus, leading to distinct symptoms associations. These results advocated that constellation of sleep alterations may define distinct disorders.

The current study postulates that the detected REM abnormalities in adolescent subjects with borderline personality disorder may be considered as trait markers for BPD rather than being state markers.

Strengths and Limitations:

The study focuses on REM sleep abnormalities in adolescent patients with borderline personality, where there is paucity of studies in this age group. Assessment of REM sleep including REM density was undertaken with standardized objective measures. The relatively small sample size was a limitation due to difficulty in finding BPD patients in adolescent age without comorbid psychiatric or substance use disorders. Absence of a habituation night and delayed phase sleep rhythm among most of subjects, being adolescents that were investigated in a weekend night may be another possible limitation. On the other hand, Bastien et al. (2008) suggested that patients with BPD may feel more comfortable and safer in the sleep lab and therefore have improved sleep in-lab. Although comorbid major depression was excluded, the researchers could not exclude patients with depressive symptoms, as these symptoms are common presentation of the affective dysregulation found in these patients.

Conclusion

REM sleep abnormalities are found in adolescent patients with borderline personality disorder, which may be considered as trait markers for BPD. The current findings could have important implications for assisting the psychiatrist in the identification of sleep abnormalities in young people with risk of developing BPD for early intervention.

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