INTRODUCTION

REM sleep behavior disorder (RBD) is a parasomnia characterized by loss of REM sleep-related muscle atonia and consequent dream enactment during sleep. RBD patients are at risk of harming themselves or others during dream enactment. RBD is known to be associated with other neurodegenerative diseases such as Parkinson’s disease (PD) and Lewy body dementia. Additionally, psychiatric symptoms, such as anxiety and alexithymia, are known to be associated with RBD. Therefore, RBD treatment should focus not only on symptom resolution but also on the evaluation and treatment of comorbid disorders.

Unlike anxiety and alexithymia, no consensus has been reached on the relationship between depression and RBD. Some studies have claimed that depression is not associated with RBD, but one study revealed a tendency for RBD to be associated with depression. Old age and neurodegenerative disorders are risk factors for both RBD and depression and may support the hypothesis that RBD is associated with depression. In support of this idea, a recent case control study showed that patients with idiopathic RBD were more likely to report comorbid depression than were controls. However, this recent study was limited in that only histories of physician-diagnosed depression were assessed, and it ignored the possibility that some depressed RBD patients had not been diagnosed.

In this study on RBD patients, we examined the relationship between depression (and associated factors) and RBD.

METHODS

Subjects

In total 94 RBD patients (mean age: 61.9±12.7 years, males: 70.2%) diagnosed as RBD were examined using detailed clinical histories, the Beck Depression Inventory (BDI), the Epworth Sleepiness Scale (ESS), and nocturnal polysomnography (PSG).
Reduced Dream Recall in Depressed RBD

70.2%) were included and their clinical and laboratory data were collected. These data were obtained between January, 2010 and May, 2014 at the Center for Sleep and Chronobiology, Seoul National University Hospital. The RBD diagnosis was made using the International Classification of Sleep Disorders (second edition; ICSD II) criteria,\(^1\) based on nocturnal polysomnography (PSG) data. Nocturnal PSGs were conducted and scored by trained technologists using standardized methods,\(^2\) and the results were finally read by trained sleep physicians. The study protocol was approved by the Institutional review board of Seoul National University Hospital.

**Measurements**

In 94 RBD patients, medical records, replies to self-report questionnaires and nocturnal PSG data were reviewed. The Beck Depression Inventory (BDI)\(^3\) was used to assess the level of depressed mood in patients diagnosed with RBD. Different BDI cut-off score can be used, i.e., 8 for screening and 16 for diagnosis, so we used a cutoff score of 11 because we sought to assess depressed mood with high sensitivity while avoiding low specificity.\(^4\) We defined patients with total BDI scores >11 as depressed, and those with scores ≤11 as non-depressed. The Epworth Sleepiness Scale (ESS) was used to assess the general level of daytime sleepiness.\(^5\)

We collected relevant clinical characteristics, including age at RBD diagnosis, reported RBD onset-time, history of injury during sleep, recall of enacted dreams, history of psychiatric disorders, history of neurological disorders, and any family history of RBD.

**Statistical analyses**

Statistical analyses were performed using the SPSS software (ver. 21). The \(\chi^2\) and t-tests were used to compare categorical and continuous variables, respectively. Parameters significantly correlated with depressed mood were subjected to logistic regression analysis to determine the variables that reliably identified patients with depressed mood. The significance level (p) was set at <0.05.

**RESULTS**

The RBD patients in this study were 66 males (70.2%) and 28 females (29.8%). The number of patients with a history of neurological disorders was 10 (10.6%), including five (5.3%) patients with Parkinson's disease or Parkinsonism and five (5.3%) patients with conditions including cerebral stroke and dementia. The number of patients with a history of psychiatric disorders was 18 (19.1%), including six (6.4%) patients with mood disorder, five (5.3%) with anxiety disorder, five (5.3%) with sleep disorder, and two (2.1%) patients with other conditions such as alcohol dependence and somatoform disorder.

As shown in Table 1, comparisons between male and female patients in terms of clinical characteristics showed no significant differences. Also, BDI and ESS scores did not differ significantly between males and females. Table 2 presents the nocturnal polysomnographic characteristics of study patients and comparisons between male and female patients. The N2 and N3 sleep percentages were higher in female than in male patients (49.6±7.9% vs. 44.8±10.7%; p=0.036; 9.6±7.3% vs. 5.3±6.8%; p=0.007, respectively, all t-tests). Sleep latency and REM latency in female RBD patients were longer than those in males (22.9±25.8 min vs. 10.3±10.9 min; p=0.018; 140.3±64.6 min vs. 108.0±65.9 min; p=0.031, respectively, all t-tests). Other PSG parameters did not differ significantly between males and females.

The mean BDI score of all patients was 12.4±10.3. Of them, 42 (44.7%) patients were depressed (BDI >11). Depressed RBD patients were less able to recall enacted dreams than were non-depressed ones (61.9% vs. 86.5%; p=0.008, \(\chi^2\) test) (Figure 1). As shown in Table 3, depressed patients had a higher respiratory disturbance index (17.8±19.9 vs. 9.5±10.2; p=0.017, t-test) and were more likely to have a history of psychiatric disorders including alcohol dependence and somatoform disorder.

**Table 1. Clinical characteristics of RBD patients (N=94)**

| Variables                               | Total (N=94) | Male (N=66) | Female (N=28) | p-value |
|-----------------------------------------|-------------|-------------|--------------|---------|
| Age at diagnosis (years)                | 61.9±12.7   | 61.7±11.8   | 62.2±14.6    | NS      |
| Age at reported onset (years)           | 57.2±13.4   | 57.0±12.3   | 57.7±15.9    | NS      |
| Recall of enacted dreams, N (%)         | 71 (75.5)   | 51 (77.3)   | 20 (71.4)    | NS      |
| History of injury during sleep, N (%)   | 53 (62.4)   | 35 (60.4)   | 18 (66.6)    | NS      |
| History of neurological disorders, N (%)| 10 (10.6)   | 8 (12.1)    | 2 (7.1)      | NS      |
| History of psychiatric disorders, N (%) | 18 (19.1)   | 12 (18.2)   | 6 (21.4)     | NS      |
| Family history of RBD, N (%)            | 1 (1.1)     | 0 (0.0)     | 1 (3.6)      | NS      |
| BDI score                               | 12.4±10.3   | 11.0±8.6    | 15.1±11.1    | NS      |
| ESS score                               | 8.1±4.3     | 8.5±4.4     | 7.1±3.9      | NS      |

The values are means±standard deviation. *N=85. p<0.05. RBD: REM sleep behavior disorder, BDI: Beck Depression Inventory, ESS: Epworth Sleepiness Scale, NS: not significant.
Table 2. Nocturnal polysomnographic characteristics of RBD patients (N=94)

| Variables       | Total (N=94) | Male (N=66) | Female (N=28) | p-value |
|-----------------|-------------|-------------|---------------|---------|
| Total sleep time (min) | 409.1±64.9  | 409.9±60.8  | 407.3±74.7    | NS      |
| Sleep efficiency (%)  | 81.3±12.9   | 82.2±12.4   | 79.0±13.9     | NS      |
| Stage N1 (%)      | 21.4±14.1   | 22.4±10.3   | 19.3±20.6     | NS      |
| Stage N2 (%)      | 46.2±10.1   | 44.8±10.7   | 49.6±7.9      | 0.036*  |
| Stage N3 (%)      | 6.6±7.2     | 5.3±6.8     | 9.6±7.3       | 0.007*  |
| Stage REM (%)     | 22.4±9.1    | 22.7±9.9    | 21.5±6.8      | NS      |
| Sleep latency (min) | 14.0±17.6   | 10.3±10.9   | 22.9±25.8     | 0.018*  |
| REM latency (min) | 117.6±66.8  | 108.0±65.9  | 140.3±64.6    | 0.031*  |
| RDI (/h)          | 13.2±15.8   | 13.9±15.2   | 11.5±17.1     | NS      |
| PLMI (/h)         | 19.8±24.8   | 20.2±23.9   | 19.0±27.4     | NS      |

The values are means±standard deviation. *p<0.05. RBD: REM sleep behavior disorder, RDI: respiratory disturbance index, PLMI: periodic limb movement index, NS: not significant.

DISCUSSION

We aimed to explore the relationship between depression (and associated factors) and RBD and found that 44.7% of all RBD patients met the criteria for depression (BDI score >11). Compared with the prevalence of depression in the general population (21.6%), the higher incidence of depression found in this study may be clinically significant. Our finding is also higher than the 28.8% value from a previous study on RBD patients. That previous study included only patients who had been diagnosed with depression by physicians, thereby excluding non-diagnosed depressed patients. The enrollment of a higher proportion of female RBD patients in the present study might have affected the prevalence of depression in RBD patients, because females are more likely to be depressed than males and Our results showed no significant difference between males and females but tendencies toward gender differences in BDI scores and in the percentage of patients with depression were observed (p-value is 0.06 and 0.07 respectively). The data support the hypothesis that patients with RBD are more likely to be depressed.

It is notable that depressed RBD patients were less likely to recall enacted dreams than were non-depressed patients. Emotional dysregulation is known to trigger failure to recall enacted dreams, because dreams contain emotions. This study is partially supported by previous studies in which the frequencies of dream recall in alexithymic or depressive subjects were lower than those in non-alexithymic or non-depressed subjects. Taken together, the data show the possibility that RBD patients suffering from emotional dysregulation may become depressed, rendering the recall of enacted dreams less likely.

Neurodegeneration may also explain our present findings. Depression is common in patients with neurodegenerative diseases such as Parkinson’s disease, and RBD is known to be associated with such neurodegenerative disorders. Depressed RBD patients may have possibility that more neurodegenerative changes than do non-depressed patients, and it could make them less attentive and more memory-impaired. Because of these impairments, depressed RBD patients may become less likely to recall enacted dreams.

A previous study showed that enacted dreams in RBD patients had more content with aggression, such as stranger's attacks, than other forms of parasomnia. These aggressive features in the enacted dreams could be explained by cognitive...
Reduced Dream Recall in Depressed RBD

Table 3. Comparison of depressed and non-depressed RBD patients on clinical characteristics (N=94)

| Variable                              | Depressed (N=42) | Non-depressed (N=52) | p-value |
|---------------------------------------|------------------|----------------------|---------|
| Age at diagnosis (years)              | 61.2±15.2        | 62.4±10.2            | NS      |
| Age at reported onset (years)         | 55.7±17.3        | 58.2±10.0            | NS      |
| Males, N (%)                          | 25 (59.5)        | 41 (78.8)            | NS      |
| Recall of enacted dreams, N (%)       | 26 (61.9)        | 45 (86.5)            | 0.008†  |
| History of injury during sleep, N (%)*| 20 (54.0)        | 33 (68.8)            | NS      |
| History of neurological disorders, N %| 3 (7.1)          | 7 (13.5)             | NS      |
| History of psychiatric disorders, N %| 13 (31.0)        | 5 (9.6)              | 0.016†  |
| Family history of RBD, N (%)          | 1 (2.4)          | 0 (0.0)              | NS      |
| ESS                                   | 8.8±4.4          | 7.6±4.1              | NS      |
| RDI (/h)                              | 17.8±19.9        | 9.5±10.2             | 0.017†  |
| PLMI (/h)                             | 16.8±22.7        | 22.3±26.4            | NS      |

The values are means±standard deviation. *N=85, †p<0.05. RBD: REM sleep behavior disorder, ESS: Epworth Sleepiness Scale, RDI: respiratory disturbance index, PLMI: periodic limb movement index, NS: not significant

Table 4. Comparison of depressed and non-depressed RBD patients on nocturnal polysomnographic characteristics (N=94)

| Variables                   | Depressed (N=42) | Non-depressed (N=52) | p-value |
|-----------------------------|------------------|----------------------|---------|
| Total sleep time (min)      | 411.9±67.8       | 406.9±63.0           | NS      |
| Sleep efficiency (%)        | 81.1±14.3        | 81.4±11.8            | NS      |
| Stage N1 (%)                | 22.1±18.2        | 20.8±9.9             | NS      |
| Stage N2 (%)                | 47.5±10.3        | 45.2±10.0            | NS      |
| Stage N3 (%)                | 6.8±6.2          | 6.4±8.0              | NS      |
| Stage REM (%)               | 21.0±7.6         | 23.4±10.0            | NS      |
| Sleep latency (min)         | 17.7±23.1        | 11.1±10.7            | NS      |
| REM latency (min)           | 122.0±62.7       | 114.1±70.4           | NS      |

The values are means±standard deviation. p<0.05. RBD: REM sleep behavior disorder, NS: not significant

Table 5. Risk factors associated with depression in RBD patients (N=94)

| Variable                        | OR    | 95% CI      | p-value |
|---------------------------------|-------|-------------|---------|
| Recall of enacted dreams        | 0.33  | 0.11±0.95   | 0.041*  |
| History of psychiatric disorders| 4.74  | 1.44±15.60  | 0.011*  |
| RDI                             | 1.04  | 1.00±1.07   | 0.029*  |

The values are means±standard deviation. *p<0.05. RBD: REM sleep behavior disorder, RDI: respiratory disturbance index, OR: odds ratio, CI: confidence interval

Thus, enacted dreams in RBD may have clinical importance in predicting the possible onset of neurodegeneration. In summary, we found that about half of all RBD patients met our depression criteria. These depressed RBD patients were less likely to recall enacted dreams than were non-depressed ones. It may be important to carefully examine mood in RBD patients to detect depressive symptoms in a timely manner.
REFERENCES

1. Schenck CH, Bundlie SR, Ettinger MG, Mahowald MW. Chronic behavioral disorders of human REM sleep: a new category of parasomnia. Sleep 1986;9:293-308.

2. Sicilari E, Khattami R, Urbanik E, Nohili L, Mahowald MW, Schenck CH, et al. Violence in sleep. Brain 2010;133:3494-3509.

3. Boeve BF, Silber MH, Ferman TJ, Lucas JA, Parisi JE. Association of REM sleep behavior disorder and neurodegenerative disease may reflect an underlying synucleinopathy. Mov Disord 2001;16:622-630.

4. Godin I, Montplaisir J, Gagnon JE, Nielsen T. Alexithymia associated with nightmare distress in idiopathic REM sleep behavior disorder. Sleep 2013;36:1957-1962.

5. Molano J, Boeve BF, Roberts R, Geda YV, Knopman D, Tangalos E, et al. Anxiety and apathy are associated with probable REM sleep behavioral disorder among cognitively normal elderly subjects: the Mayo clinical study of aging. Neurology 2008;70(Suppl 1):A146.

6. Postuma RB, Lang AE, Massicotte-Marquez J, Montplaisir J. Potential early markers of Parkinson disease in idiopathic REM sleep behavior disorder. Neurology 2006;66:845-851.

7. Wing YK, Lam SP, Li SX, Yu MW, Fong SY, Tsioh JM, et al. REM sleep behaviour disorder in Hong Kong Chinese: clinical outcome and gender comparison. J Neurol Neurosurg Psychiatry 2008;79:1415-1416.

8. Beck AT, Copeland JR, Prince MJ. Review of community prevalence of depression in Parkinson’s disease. Mov Disord 2006;21:307-311.

9. Reijnders JS, Ehrt U, Weber WE, Aarsland D, Leentjens AF. A systematic review of prevalence studies of depression in Parkinson’s disease. Mov Disord 2005;20:183-189.

10. Frauscher B, Jennum P, Ju YE, Postuma RB, Arnulf I, Cochen De Cock V, et al. Comorbidity and medication in REM sleep behavior disorder: a multicenter case-control study. Neurology 2014;82:1076-1079.

11. American Academy of Sleep Medicine. The International Classification of Sleep Disorders: Diagnostic and Coding Manual, ICD-2. Westchester, IL: American Academy of Sleep Medicine; 2005.

12. Iber C, Ancoli-Israel S, Chesson AL Jr, Quan SF; for the American Academy of Sleep Medicine. The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications. 1st ed. Westchester, IL: American Academy of Sleep Medicine; 2005.

13. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). Washington, DC: The American Psychiatric Association; 2013.

14. HG Lee et al. Sleep Med 2015;16:414-418.

15. Silva A, Andersen ML, De Mello MT, Bettencourt LR, Peruzzo D, Tufik S. Gender and age differences in polysomnography findings and sleep complaints of patients referred to a sleep laboratory. Braz J Med Biol Res 2008;41:1067-1075.

16. Zhou J, Zhang J, Li Y, Lu L, Li Z, Lei F, et al. Gender differences in REM sleep behavior disorder: a clinical and polysomnographic study in China. Sleep Med 2015;16:414-418.

17. American Academy of Sleep Medicine. The validity of the Beck Depression Inventory as a screening and diagnostic instrument for depression in patients with Parkinson’s disease. Mov Disord 2000;15:1221-1224.

18. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14:540-545.

19. Jylha P, Isometsa E. The relationship of neuroticism and extraversion to symptoms of anxiety and depression in the general population. Depress Anxiety 2006;23:281-289.

20. Kuehner C. Gender differences in unipolar depression: an update of epidemiological findings and possible explanations. Acta Psychiatr Scand 2003;108:163-174.

21. Chang A, Chen K, Chen C, Gao J, Lin CH, et al. Violence in sleep. Brain 2010;133:3494-3509.

22. Bodkin CL, Schenck CH. Rapid eye movement sleep behavior disorder in women: relevance to general and specialty medical practice. J Womens Health (Larchmt) 2009;18:1955-1963.

23. Armitage R, Rochlen A, Fitch T, Trivedi M, Rush AJ. Dream recall and major depression: a preliminary report. Dreaming 1995;5:189.

24. Raskind MA. Diagnosis and treatment of depression comorbid with neuropsychiatric disorders. Am J Med 2008;121(Suppl 2):S28-S37.

25. Uguzzoni G, Gollomb JL, de Fontenay AN, Leu-Semenescu S, Brion A, Arnulf I. Fight or flight? Dream content during sleepwalking/sleep terror vs. rapid eye movement sleep behavior disorder. Sleep Med 2013;14:391-398.

26. Scand 2003;108:163-174.

27. De Gennaro L, Ferrara M, Cristiani R, Curcio G, Martiradonna V, Bertini M. Alexithymia and dream recall upon spontaneous morning awakening. Psychosom Med 2003;65:301-306.

28. Molano J, Boeve BF, Roberts R, Geda YV, Knopman D, Tangalos E, et al. Anxiety and apathy are associated with probable REM sleep behavioral disorder among cognitively normal elderly subjects: the Mayo clinical study of aging. Neurology 2008;70(Suppl 1):A146.

29. Reijnders JS, Ehrt U, Weber WE, Aarsland D, Leentjens AF. A systematic review of prevalence studies of depression in Parkinson’s disease. Mov Disord 2005;20:183-189.

30. Frauscher B, Jennum P, Ju YE, Postuma RB, Arnulf I, Cochen De Cock V, et al. Comorbidity and medication in REM sleep behavior disorder: a multicenter case-control study. Neurology 2014;82:1076-1079.

31. American Academy of Sleep Medicine. The International Classification of Sleep Disorders: Diagnostic and Coding Manual, ICD-2. Westchester, IL: American Academy of Sleep Medicine; 2005.

32. Iber C, Ancoli-Israel S, Chesson AL Jr, Quan SF; for the American Academy of Sleep Medicine. The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications. 1st ed. Westchester, IL: American Academy of Sleep Medicine; 2007.

33. Beck AT, Steer RA, Carbin MG. Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. Clin Psychol Rev 1988;8:77-100.