

A Unique Pattern on Memory Testing in Dementia Screening Predicts Obstructive Sleep Apnea

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ABSTRACT

Objectives: The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is used to screen for dementia in many Wisconsin Alzheimer Institute memory care clinics. After observing a pattern of lower scores for immediate memory than for delayed memory (immediate memory < delayed memory) that seemed to predict obstructive sleep apnea in patients seen in our memory care clinic, we aimed to confirm the validity of this finding.

Methods: We retrospectively identified all patients seen in our memory care clinic from December 2011 through December 2014 who completed the RBANS. The frequency of obstructive sleep apnea was determined among those with the pattern of interest (immediate memory < delayed memory).

Results: Among 191 patients who met the inclusion criteria, 81 (42%) displayed the immediate memory < delayed memory pattern. Of these, 54 patients had been or were subsequently tested for obstructive sleep apnea; 35 (65%) were positive. In the positive group, the mean age was 74 years; 60% were women.

Conclusions: Obstructive sleep apnea is a known risk factor for cognitive dysfunction. It is a potentially treatable cause of memory loss that can be clinically silent. This study shows that a unique pattern (immediate memory < delayed memory) on the RBANS commonly used at memory care clinics can identify a group of patients who can be evaluated and treated for this common and remediable condition.

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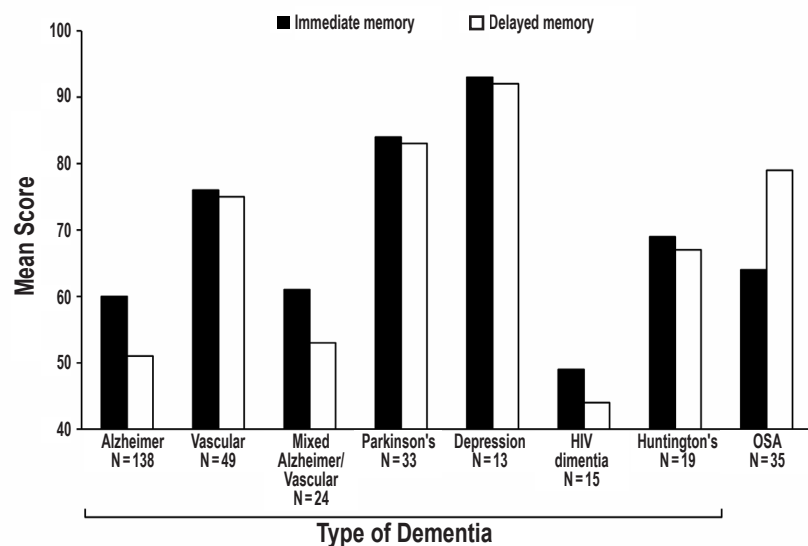
INTRODUCTION

Alzheimer disease and other dementias are common disorders with limited treatment options. One goal of memory care clinic evaluations is to identify and treat potentially reversible causes of dementia. Such identification relies on findings from patient history and examination. Neuropsychiatric testing can determine the severity of deficits and may be able to distinguish different forms of dementia, such as frontotemporal dementia or Alzheimer disease. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)¹ is a robust yet brief standardized screening tool used to evaluate patients for memory loss. It measures several cognitive domains, including immediate memory, delayed memory, visuospatial abilities, attention, and language, that can be affected by an underlying dementing process. The mean (SD) score on the RBANS is 100 (10), and the usual pattern in dementia is a decrease in scores across all domains. In every reported cognitive disorder,

the *delayed memory* score (recall at 30 minutes) is considerably more affected (decreased) than the *immediate memory* score (recall at 5 minutes). In the memory care clinic setting, the test can be repeated as often as every 6 months, which allows for ongoing assessment of cognitive decline.

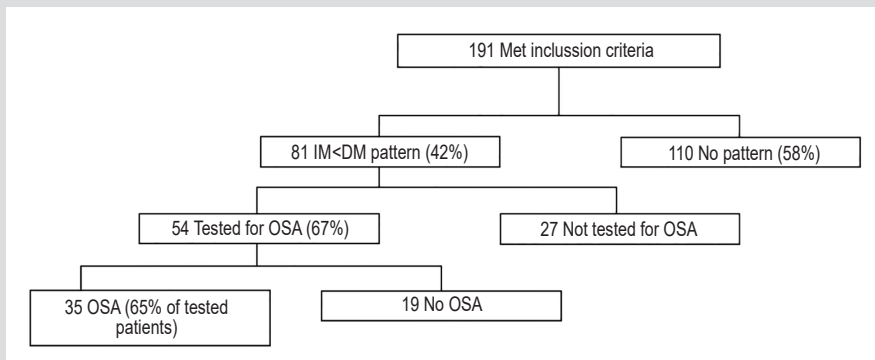
We noted a pattern of lower scores for immediate memory than for delayed memory (immediate memory < delayed memory) in patients with known or suspected obstructive sleep apnea. A

Figure 1. Typical RBANS Patterns for Various Dementias Compared With OSA Data From Current Study



Bars show mean scores for various cohorts. A mean (SD) score of 100 (10) indicates the 50th percentile. Abbreviations: OSA, obstructive sleep apnea; RBANS, Repeatable Battery for the Assessment of Neuropsychological Status. Data from Randolph.¹

Figure 2. Patient Flow Chart



Abbreviations: IM<DM, immediate memory less than delayed memory; MCC, memory care clinic; OSA, obstructive sleep apnea.

memory < delayed memory pattern had a 35% rate of obstructive sleep apnea. Based on these findings, we expanded our study to encompass 3 years of patient data.

METHODS

We conducted a retrospective chart review of all patients seen in our memory care clinic between December 2011 and December 2014 who met the inclusion criteria of age 20 to 89 years with documentation of RBANS evaluation. As part of the intake process, all patients had completed a routine screening questionnaire, which included questions regarding snoring, apnea episodes, and excessive sleepiness, as well as the Epworth Sleepiness Scale.

We identified patients who exhibited the pattern of interest (immediate memory < delayed memory), then evaluated those who were tested for sleep apnea to determine the percentage who had a diagnosis of obstructive sleep apnea based on standard criteria. The sleep evaluation was done using standard criteria polysomnography in an accredited sleep disorder center. In patients with the pattern of interest who were evaluated after the initial pilot study, we recommended overnight pulse oximetry for those who had not been formally tested for obstructive sleep apnea, whether or not they had a clinical indication for further testing. In patients without the pattern of interest, we did further testing only if clinical indicators for obstructive sleep apnea were present. We also evaluated body mass index (BMI) in all patients.

review of 1 year of data in our clinic showed that this pattern seemed to predict obstructive sleep apnea. The patients often did not have typical sleep apnea symptoms and, as such, the diagnosis most likely would have been missed had we not investigated this pattern further.

The immediate memory < delayed memory pattern is opposite what typically is seen in dementias (Figure 1). In fact, in our clinic, patients with the usual pattern (immediate memory greater than delayed memory) rarely had diagnosed or suspected obstructive sleep apnea syndrome. In an earlier pilot study that we conducted, a screen of 43 patients who had the typical pattern of immediate memory > delayed memory showed a 14% rate of obstructive sleep apnea; in contrast, patients with the immediate

Standard Protocol Approvals, Registrations, and Patient Consent

The Mayo Clinic Institutional Review Board reviewed and approved the study protocol. No informed consent was required due to the retrospective study design. Patients were identified using a query of electronic medical records.

RESULTS

A total of 191 patients met inclusion criteria for the study period. Of this group, 81 patients (42%) exhibited the immediate memory < delayed memory pattern of interest and 54 (67%) had been or were subsequently tested for obstructive sleep apnea (Figure 2). In the group not tested (n=27), many patients had declined or were unable to complete testing. Among the 54 patients tested

with polysomnography, 35 (65%) met criteria for obstructive sleep apnea (Figure 2). The mean age of the positive group was 74 years; 60% were women.

BMI was similar for patients with and without the pattern of interest (27.3 vs 26.6 kg/m²). A review of the intake questionnaires of patients seen in the memory care clinic demonstrated that many patients who were ultimately identified as having obstructive sleep apnea did not exhibit typical symptoms (eg, excessive daytime sleepiness, observed apneas, loud snoring, stop-breathing events) that would have suggested sleep apnea. Many patients with immediate memory < delayed memory also did not have the body habitus typically seen in obstructive sleep apnea.

DISCUSSION

Sleep has an important role in memory function.^{2,3} Obstructive sleep apnea has been shown to affect cognitive function, and treatment has shown variable effects.^{4,5} Obstructive sleep apnea is present in 44% of men older than 65 years and 7% of women older than 65 years.⁶ In our study, unexpected obstructive sleep apnea was found on the basis of RBANS testing with fairly high frequency. Since only two-thirds of the patients with the immediate memory < delayed memory pattern in our study group were tested with polysomnography, our results likely represent an underestimate of the frequency of obstructive sleep apnea in this patient population. We found no previous reports of using screening tests in a memory care clinic setting to predict obstructive sleep apnea, which makes our finding unique.

Memory loss in patients with obstructive sleep apnea may be due to the direct effect of low oxygen saturation on susceptible areas of the brain, including the hippocampus.⁷ Disrupted sleep, which is common in patients with obstructive sleep apnea, also has been reported to decrease memory function. Among the causes that might explain this finding are effects on sleep architecture,⁸ decreased clearance of metabolites in patients with sleep disruption,⁹ and increased amyloid pathologic processes in patients with poor sleep.¹⁰⁻¹²

Different types of neurologic disorders, including Alzheimer disease and vascular dementia, show different patterns on the RBANS test, but the pattern in all reported disorders shows higher scores for immediate memory than delayed memory.

CONCLUSION

Our study shows that a unique pattern noted on the RBANS can predict obstructive sleep apnea in a memory care clinic setting. This pattern (immediate memory < delayed memory) has not been reported in other forms of dementia (Figure 1). The finding of obstructive sleep apnea in our memory care clinic patients based on the unique pattern of immediate memory < delayed memory was common and often unexpected because patients did not have typical symptoms on standard obstructive sleep apnea screening criteria. The cause of this unique pattern in patients with obstructive

sleep apnea is uncertain, and further investigation using a case-control study is planned.

Treatment of obstructive sleep apnea in memory care clinic patients can result in substantial improvement in cognitive function, especially if diagnosed early. Aggressive evaluation for obstructive sleep apnea in patients with the pattern of immediate memory < delayed memory is encouraged.

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REFERENCES

1. Randolph C. *Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Manual*. San Antonio, TX: The Psychological Corporation; 1998.
2. Fulda S, Schulz H. Cognitive dysfunction in sleep disorders. *Sleep Med Rev*. 2001;5(6):423-445.
3. Bubus OM, Brannick M, Mortimer J, et al. Sleep, cognitive impairment, and Alzheimer's disease: A systematic review and meta-analysis. *Sleep*. 2017;40(1). doi:10.1093/sleep/zsw032.
4. Olaithe M, Bucks RS. Executive dysfunction in OSA before and after treatment: a meta-analysis. *Sleep*. 2013;36(9):1297-1305. doi:10.5665/sleep.2950.
5. Dalmases M, Sole-Padullés C, Torres M, et al. Effect of CPAP on cognition, brain function, and structure among elderly patients with OSA: a randomized pilot study. *Chest*. 2015;148(5):1214-1223. doi:10.1378/chest.15-0171.
6. Young T, Skatrud J, Peppard PE. Risk factors for obstructive sleep apnea in adults. *JAMA*. 2004;291(16):2013-2016. doi:10.1001/jama.291.16.2013.
7. Gale SD, Hopkins RO. Effects of hypoxia on the brain: neuroimaging and neuropsychological findings following carbon monoxide poisoning and obstructive sleep apnea. *J Int Neuropsychol Soc*. 2004;10(1):60-71. doi:10.1017/S1355617704101082.
8. Pase MP, Himali JJ, Grima NA, et al. Sleep architecture and the risk of incident dementia in the community. *Neurology*. 2017;89(12):1244-1250. doi: 10.1212/WNL.0000000000004373.
9. Xie L, Kang H, Xu Q, et al. Sleep drives metabolite clearance from the adult brain. *Science*. 2013;342(6156):373-377. doi:10.1126/science.1241224.
10. Spira AP, Gamaldo AA, An Y, et al. Self-reported sleep and beta-amyloid deposition in community-dwelling older adults. *JAMA Neurol*. 2013;70(12):1537-1543. doi:10.1001/jamaneurol.2013.4258.
11. Sprecher KE, Kosciak RL, Carlsson CM, et al. Poor sleep is associated with CSF biomarkers of amyloid pathology in cognitively normal adults. *Neurology*. 2017;89(5):445-453. doi:10.1212/WNL.0000000000004171.
12. Spira AP, Ju YS. Self-reported sleep and Alzheimer disease CSF biomarkers: a wake-up call. *Neurology*. 2017;89(5):419-420. doi: 10.1212/WNL.0000000000004189.

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