Obstructive Sleep Apnea in Dementia

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Emerging evidence suggested a link between Obstructive Sleep Apnea (OSA) and cognitive decline, including dementia.

The severity of cognitive impairment has been reported to be directly correlated with the degree of OSA.
Neurodegenerative changes including cerebral volume loss have also been reported due to OSA.

Various vascular diseases, including hypertension, diabetes mellitus, hyperlipidemia, and heart diseases are also significant comorbidities on patients with OSA and dementia.
Objectives

- To report the occurrence of OSA in patients with dementia in the Island of Guam and to correlate the severity of OSA with the results of the neuropsychological testing and neuroimaging studies.

- To report the prevalence of comorbid vascular diseases in patients with OSA and dementia.
Methods

- A retrospective analysis of medical records of patients evaluated in The Neurology Clinic in Guam with the diagnosis of OSA and dementia from August 2006 to June 2016 was conducted.

- The severity of OSA was correlated with the findings of the Neuropsychological testing and Brain MRI or CT scan results.

- The diagnosis of vascular diseases at the initial consultation was identified and the prevalence was compared across the different severities of dementia.
Results

- 359 patients
- 17% diagnosed with OSA
- 58% male, 42% female
- Average age of diagnosis of dementia
  - 67 years old for male
  - 66 years old for female
Gender Distribution

- Male: 58%
- Female: 42%
Number of patients with OSA
Neuroimaging Findings

Normal Brain MRI

Various Stages of Global Cerebral Atrophy
Mild OSA and Cerebral Atrophy
Moderate OSA and Cerebral Atrophy

- Moderate Atrophy: 60%
- Mild Atrophy: 20%
- No Atrophy: 10%
Severe OSA and Cerebral Atrophy

![Graph showing the percentage of individuals with different levels of cerebral atrophy: 45% Moderate Atrophy, 35% Mild Atrophy, 25% No Atrophy.]

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OSA and Neuropsychological Testing

- Neurotrax computerized based NPT
- Domain Tested:
  - Memory
  - Executive Function
  - Attention
  - Information Processing Speed
  - Visual Spatial
  - Verbal Function
  - Motor Skills
The Global Cognitive Score is computed as the average of the available index scores. Normalized scores are standardized relative to cognitively healthy individuals of similar age and educational level and fit to a scale with mean=100 and SD=15.

<table>
<thead>
<tr>
<th>Neuropsychological Test</th>
<th>Global Cognitive Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&gt; / - 100</td>
</tr>
<tr>
<td>Mild Impairment</td>
<td>99 - 85</td>
</tr>
<tr>
<td>Moderate Impairment</td>
<td>84 - 70</td>
</tr>
<tr>
<td>Severe Impairment</td>
<td>&lt; 70</td>
</tr>
</tbody>
</table>
Moderate OSA and Neuropsych Testing

Bar chart showing the distribution of normal NPT, mild NPT, moderate NPT, and severe NPT.
Severe OSA and Neuropsych Testing

![Bar chart showing percentage of normal, mild, moderate, and severe cases.](chart.png)
Stroke and White Matter Changes in Neuroimaging Studies

- Stroke
- Leukoaraiosis

Lacunar infarcts
Leukoaraiosis
Vascular Diseases in Dementia

![Bar chart showing prevalence of conditions in dementia](chart.png)
Discussion

- OSA ~ 2-4% of middle aged individuals
- It is defined as Apnea Index of 5 or > per hr.
- Characterized by:
  - chronically fragmented sleep
  - intermittent hypoxemia – this is associated with
    - increased sympathetic vasoconstriction
    - decreased vascular protective mechanism
- both contribute to structural and functional changes in the vasculature of the brain
- can cause cognitive dysfunction in OSA
Co-morbidities of OSA

- Neurocognitive impairment
- Cardiovascular morbidities
  - Hypertension
  - Heart disease
  - Diabetes mellitus
  - Obesity
- Reduced quality of life
- Impaired work performance
- Increased risk of accidents
- Depression, anxiety
Hippocampus and OSA

- Hippocampus is extremely sensitive to hypoxic damage
- Hippocampal changes in OSA may be associated with
  - Memory impairment
  - Attentional impairment
  - Executive impairment
- Utilizing Voxel-based morphology showed focal reduction in Gray Matter volume in the:
  - left hippocampus
  - left posterior parietal cortex
  - right superior frontal gyrus
White Matter Changes in OSA

- White matter changes abnormalities may be present in patients with vascular diseases as a result of chronic apneic events.
- Vascular compromise and endothelial dysfunction in OSA can damage small vessels in the brain, which can result in small vessel and white matter ischemia.
- Alteration in the projection fibers between affected brain structures due to cellular damage as a consequence from ischemia, hypoxic or inflammatory processes accompanying OSA.
Obstructive Sleep Apnea

- OSA impairs structural integrity of several brain regions
- Hypoxia, hypertension, endothelial dysfunction, inflammation and oxidative stress are noted in both OSA and Alzheimer disease
- OSA can upregulates Amyloid Beta plaques, tau hyperphosphorylation, and synaptic dysfunction, which are observed in Alzheimer Disease.
Obstructive Sleep Apnea

- Cerebral atherosclerosis and lacunar infarcts are important causes of cognitive impairment and dementia

- Hypertension, Diabetes mellitus, and Hyperlipidemia are associated with increased risk of developing dementia due to white matter disruption
OSA is a common sleep disturbance in patients with dementia.

The severity of OSA correlates closely with the degree of cerebral atrophy and global cognitive scores.

Various co-morbid vascular diseases are frequently encountered in patients with OSA and dementia, and their occurrences are highly comparable across all degrees of severity.
After CPAP treatment, there were significant improvement in memory, attention, and executive functioning.

There is evidence that structural brain abnormalities exist in regions susceptible to hypoxemia, and that they can change with treatment. These results suggest that even the negative neurological effects of hypoxemia may reverse with consistent and thorough treatment. Therefore, adherence to treatment may lead not only to clinical but also to brain-structural recovery.
While there are numerous studies that establish a clear relationship between OSA, cognitive decline and dementia, more work is needed in understanding the mechanism and processes involved.

OSA is a modifiable risk factor for cognitive dysfunction, and treating OSA prior to mild cognitive impairment may be an effective prevention strategy to reduce risk for cognitive decline and dementia.
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