Final Report

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Title of Project: Early identification of cerebral small vessel disease burden in obstructive sleep apnoea patients using advanced magnetic resonance imaging

Summary: (approximately 1,000 words)

Cerebral small vessel disease (CSVD) is a common feature of the ageing brain. It affects the small vessels of the brain and causes up to 45% of dementia and 20% of strokes. CSVD is among the major health complications an increasing number of Australians face, yet there is currently no curative treatment. Management of the traditional risk factors of CSVD is still the main approach for treating or preventing CSVD because there is evidence that brain damage can be reversed or delayed in the early stages of the disease.

Obstructive sleep apnoea (OSA) is a common sleep-breathing disorder in the general population. It affects at least 10-20% of adults, and the prevalence of OSA increases as the population ages and becomes more obese. In adults aged > 60 years, 50% of men and 23% of women have moderate to severe sleep-disordered breathing. OSA is characterised by frequent complete (apnoea) or partial (hypopnoea) upper airway collapse during sleep, limiting airflow and causing chronic intermittent hypoxia and arousals from sleep. Therefore, people with OSA have an increased risk of developing CSVD as they age. If not treated, OSA has been reported to promote CSVD progression, but the use during sleep of continuous positive airway pressure (CPAP), the first-line treatment for OSA, may allow for the healing of OSA-induced brain damage or halting progression.

The diagnosis and monitoring of CSVD rely on imaging findings. Currently, the standards for reporting vascular changes on neuroimaging criteria (STRIVE) are widely applied to evaluate structural features seen on magnetic resonance imaging (MRI). However, only severe cases of CSVD in moderate-severe OSA patients have been identified with current routine MRI protocols, and the results have been inconsistent. There is currently no MRI protocol able to identify early-stage CSVD or monitor disease progression in the early stages, when disease management would benefit most. More advanced imaging techniques are required to detect a subtler level of damage when brain damage can still be reversed with interventions.

Thus, this project aimed to develop an advanced imaging protocol that can characterise vascular damage of early CSVD in mid-life people with OSA that can't be seen using the standard MRI protocol.

Hypothesis vs Findings

We hypothesise that the severity of OSA will be associated with greater damage, as captured with our advanced MRI protocol.

We found that our advanced imaging protocol was more sensitive to characterise fine structural changes in white matter and brain microvasculature neurochemical and perfusion abnormalities in early CSVD than existing STRIVE criteria (i.e., standard practice). Using this advanced protocol, we were also able to show that participants with greater OSA severity had more severe brain damage.

Unanswered Questions. Results could be generalised to other high-risk populations because CSVD is frequent in patients with cardiovascular disease and associated risk factors, but this needs to be verified.

What these research outcomes mean. Those findings support the utility of more advanced imaging scans in early CSVD diagnosis.

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