

## CLINICAL VIGNETTE

# Improvement in Cognitive Function Post Cardiac Pacemaker

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### Introduction

Cognitive impairment, excluding dementia, is most commonly associated with aging, affecting an estimated 22% of all persons over the age of 71.<sup>1</sup> When impaired patients are identified, primary care physicians will want to rule out reversible causes of cognitive impairment. If no significant abnormalities are detected, the cause is generally attributed to an irreversible dementing process. We report an elderly male with declining cognitive function, as measured by serial Montreal Cognitive Assessment (MoCA),<sup>2</sup> who improved dramatically following pacemaker implantation for 3<sup>rd</sup> degree AV block.

### Case Report

A 90-year-old male historian and author with sensorineural hearing loss, hypertension and hyperlipidemia, presented with declining short-term memory over a period of several months. Medications were aspirin 81mg, amlodipine 5mg, simvastatin 20mg, and a vitamin B12 supplement. He drank 1 glass of red wine nightly. Other than occasional urinary urgency, seasonal rhinitis, and chronic bilateral hearing loss, review of systems was unremarkable. On physical examination, blood pressure was 140/75 mmHg, heart rate was 90 beats per minute and regular, oxygen saturation was 94%, temperature 98.3F and body mass index was 27kg/m<sup>2</sup>. Cardiorespiratory and abdominal examinations were normal. Gait was unimpaired and neurologic exam was non-focal. He scored 4/5 on the Mini-Cog,<sup>3</sup> consistent with a low likelihood of dementia. Depression screen was negative with a Geriatric Depression Scale<sup>4</sup> of 2/15. The patient and his family stated that he had a complete work up for “memory problems” a few years ago at another medical center, including computerized axial tomography of the head. He was told that the findings were “age appropriate”. He was still concerned about loss of cognitive function and wanted a second opinion despite the low likelihood of dementia on his Mini-Cog screen. On the initial MoCA, he scored 24/30, consistent with mild cognitive impairment. Brain magnetic resonance imaging showed chronic microvascular ischemic changes. Laboratory results were as follows: B12 level 1602 pg/ml (high), rapid plasma reagin (RPR) negative, thyroid stimulating hormone 1.41 uIU/ml (normal). Complete blood count, electrolytes, folic acid, and liver function tests were unremarkable. Serum creatinine was elevated at 1.60 mg/dl (high) and total vitamin D was insufficient at 24 ng/dl.

The patient’s subjective memory impairment worsened over 2 years. This was accompanied by several unexplained falls,

fatigue, and anhedonia. Serial MoCA results indicated progressive cognitive impairment:

08/25/2014	24/30
01/25/2016	26/30
02/03/2016	23/30
06/01/2016	19/30
08/03/2016	18/30
10/17/2016 (post pacemaker)	27/30

Table 1. Date and score of MoCA

On the last geriatric psychiatry evaluation, the impression was “MOCA 18/30 today with deficits in memory, attention and language. Recent MRI from outside hospital shows chronic ischemic changes in mid-brain and pons with other ischemic white matter changes. It is likely he has vascular dementia with possible Alzheimer’s. He had not started donepezil due to concern for side effects, but after discussion of risks, benefits and side effects today, he has decided to start it”. However, the patient and his family ultimately decided that he would not take donepezil, out of concern for side effects.

He was found on the floor by a family member after an unexplained fall months later, which prompted a hospitalization for syncope. Inpatient work up was inconclusive and he was scheduled for ambulatory cardiac monitoring using the ZIO patch to rule out occult arrhythmia. He fell again two weeks later after leaning back in his chair. The ZIO patch was placed shortly after with the following 14-day result: “Nine episodes of 3<sup>rd</sup> degree atrioventricular block, lasting a total of 11 minutes, 45 seconds associated with ventricular rate of 50’s. The relative rapid ventricular escape rhythm and similarity to normal beats both suggest that this is AV nodal type of third degree block. The patient provided a diary in which no symptoms were reported”.

The patient was urgently admitted for treatment of 3<sup>rd</sup> degree heart block. He underwent uncomplicated dual chamber pacemaker implantation and was discharged the following day. One month later, the patient scored 27/30 on the MoCA. He reported feeling more energy and the ability to think more clearly. Mood was noticeably more upbeat.

## **Discussion**

When cognitive impairment is identified, clinicians usually perform a “dementia work up” comprised of a focused history, a depression screen, a thorough medication reconciliation, physical exam, vitamin B12 and folic acid levels, RPR for latent syphilis, TSH for thyroid dysfunction, testing for human immunodeficiency virus if indicated, and brain imaging (CT and/or MRI). If there are no significant findings, the impairment is presumed to be due to a chronic, irreversible neurodegenerative condition. Our patient’s initial MoCA results were consistent with mild cognitive impairment, but over a period of a year, his cognition declined to the level of a major neurocognitive disorder (dementia), with successive MoCAs of 19 and 18.<sup>2</sup>

Pharmacologic treatments for dementia are limited at this time. Cholinergic medications such as donepezil, galantamine, and rivastigmine are commonly used, but known side effects include heart block, including 3<sup>rd</sup> degree AV block.<sup>5</sup> As with most medications, side effects are more likely to occur in the geriatric population. Given our patient’s subsequent finding of occult 3<sup>rd</sup> degree AV block, it is fortunate that he chose not to take donepezil when it was recommended. It is unlikely that this medication would have provided any benefit, as his cognitive decline appeared to be due more to a treatable cardiovascular cause rather than a neurodegenerative process.

We conducted a review of the literature on reversible cognitive impairment due to brain hypoperfusion in the elderly with spouse results. While cardiovascular disease is recognized as a major risk factor for developing Alzheimer’s disease and vascular dementia,<sup>6</sup> both are considered irreversible. Two publications directly addressed the issue of reversibility of cognitive impairment following pacemaker therapy: “Cardiogenic dementia revisited” in 1991<sup>7</sup> and “Improvement of cerebral blood flow and cognitive function following pacemaker implantation in patients with bradycardia” in 1994.<sup>8</sup> Since that time, the idea that brain hypoperfusion may result in cognitive impairment that is potentially reversible has largely been supplanted by the idea that “low systemic blood pressure does not cause brain dysfunction because compensatory cerebral autoregulation prevents brain hypoperfusion from being activated.”<sup>9</sup> While this theory may be valid in the younger population, it may not be so in the elderly. The author of “Cardiovascular Risk Factors Promote Brain Hypoperfusion Leading to Cognitive Decline and Dementia” explores possible mechanisms for the loss of cerebrovascular autoregulation in the aging brain. He concludes that, “particularly in the elderly, cerebral autoregulation does not necessarily protect the brain from chronic low blood pressure and low cardiac output.”

It may seem to be almost clinically insignificant that our patient experienced 9 asymptomatic episodes of 3<sup>rd</sup> degree heart block totaling 11+ minutes over a 14-day period. However, he was a very elderly gentleman with a history of hypertension, hyperlipidemia, and sedentary lifestyle. We theorize that these important cardiovascular risk factors may have resulted in the loss of cerebrovascular autoregulation, hence heightened sensitivity to brain hypoperfusion caused by the episodes of 3<sup>rd</sup> degree heart block. The cognitive decline experienced by our

patient seems to have been reversed following pacemaker implantation, and he has experienced no more unexplained falls. We have no explanation for his improvement other than the fact that he was treated with a pacemaker. Our now 93-year old patient’s latest MoCA of 27 is considered normal for a person aged 60-71.<sup>2</sup>

## **Conclusion**

Consider occult cardiac bradyarrhythmia as an underlying cause of potentially reversible cognitive impairment, particularly when accompanied by fatigue, falls and syncope. Prior to prescribing “memory enhancers”, remember that cholinergic medications belonging to this class may worsen outcomes in patients with undiagnosed heart block.

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