Prevalence and patterns of comorbid cognitive impairment in low vision rehabilitation for macular disease

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ABSTRACT

The prevalence of comorbid cognitive impairment among older adults referred to low vision rehabilitation (LVR) for macular disease is unknown. We performed cognitive testing on 101 adults aged 65 years or older with macular disease who were referred to The Duke LVR Clinic between September 2007 and March 2008. Scores on the telephone interview for cognitive status-modified (TICS-m) ranged from 7 to 44, with 18.8% of scores below an established cutoff for cognitive impairment (≤ 27) and an additional 27.7% of scores considered marginal (28–30). On letter fluency, 46% of participants scored at least $1\times$ standard deviation (SD) below the mean for their age, gender, race, and education level, and 18% of participants scored at least $2\times$ below their demographic mean. On logical memory, 26% of participants scored at least $1\times$ below the mean for their age group and race and 6% scored at least $2\times$ below their demographic mean. High prevalence of cognitive impairment, with particular difficulty in verbal fluency and verbal memory, may compromise the success of LVR interventions among macular disease patients. Additional work is needed to develop strategies to maximize function in older adults with this common comorbidity.

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1. Introduction

Visual impairment is among the ten leading causes of disability in the United States and it is associated with shorter life expectancy and poorer quality of life (Centers for Disease Control and Prevention, 2001; McCarty et al., 2001; Vu et al., 2005). Already 14 million older Americans are affected by age-related macular degeneration and the prevalence is increasing as the population ages (Friedman et al., 2004). Macular disease is the leading cause of incurable blindness in older Americans and it is the most common reason for referral to LVR (Klein et al., 1992; Windsor and Windsor, 2001; Friedman et al., 2004).

LVR incorporates the expertise of optometrists, occupational therapists, orientation and mobility specialists, and assistive device specialists to maximize existing sight and to promote independence despite loss of vision (Edmonds and Edmonds, 2006; Markowitz, 2006). LVR can preserve and restore abilities in seniors with vision loss, but it often requires the patient to master new techniques or devices (Bourla and Young, 2006; Walter et al., 2007). Although LVR can be highly beneficial to patients with irreversible visual impairment, the utility may be limited if a patient's ability to learn new techniques and adapt to new equipment is diminished by comorbid cognitive impairment.

Cognitive impairment, like visual impairment, is common among older adults and is itself an independent risk factor for disability (McGuire et al., 2006). Previous work has demonstrated that the co-occurrence of visual and cognitive impairment in older adults is associated with an even higher risk of disability than either impairment alone (Whitson et al., 2007). Further, there is evidence of an age-associated link between vision and cognitive function. In a cross-sectional study of 687 adults aged 25–103 years, controlling for vision led to a 3.9 fold reduction in age-associated differences in cognitive function (Baltes and Lindenberger, 1997). An analysis of data from the Study of Osteoporotic Fractures (SOF) found that visual

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impairment was associated with greater than expected cognitive decline over approximately four years (Lin et al., 2004). There is evidence that Alzheimer's disease and macular degeneration may share common pathophysiology (Uhlmann et al., 1991; Klaver et al., 1999), and macular disease and cognitive impairment may develop through common underlying conditions, such as atherosclerosis.

Despite the apparent association between visual and cognitive problems and the functional and treatment-related implications of this comorbidity, the prevalence of cognitive impairment in LVR is unknown. Moreover, it is not known whether particular cognitive deficits are especially common among older adults with macular disease. A better understanding of the scope of cognitive impairment among older adults referred to LVR is likely to (1) suggest hypotheses about the possible etiologic link between visual and cognitive impairments, and (2) inform the development of effective LVR treatment strategies for individuals with this disabling comorbidity. The objective of this analysis is to describe the prevalence and patterns of cognitive dysfunction in a population of older adults with macular disease referred to an outpatient LVR program.

2. Study design and methods

2.1. Study population

Eligible participants were patients aged 65 years or older with macular disease diagnoses (age-related macular degeneration, diabetic retinopathy with macular involvement, macular edema, etc) who were evaluated in the Duke LVR Clinic between September 17, 2007 and March 27, 2008. Enrollment was restricted to patients with macular disease because it is the most common indication for referral of older adults to LVR, and the central vision loss of macular disease confers unique functional challenges and rehabilitation needs. Exclusion criteria included hearing impairment or language barriers that were severe enough to prevent in-person administration of cognitive tests. During each week of the study period, all eligible patients were invited to participate until the weekly recruitment goal (3–5 patients) was met.

Data were collected as part of an ongoing observational study to examine the consequences cognitive impairment in LVR, to explore associations between visual and cognitive parameters in this population, and to enhance LVR to account for important cognitive deficits. The present analysis is limited to data collected at the baseline interview. The study was approved by the Duke University Medical Center Institutional Review Board.

2.2. The Duke LVR clinic

This clinic coordinates a multi-disciplinary outpatient rehabilitation service within the Duke Eye Center. The LVR team includes an optometrist, a low vision device specialist, and an occupational therapist. The clinic is open three days a week (Monday, Wednesday, Thursday) and evaluates 20–25 patients each week. Referrals are accepted from Duke and community ophthalmologists and primary care physicians.

2.3. Cognitive tests

All cognitive tests were administered in person by one of two individuals trained and supervised by a clinical neuropsychologist to perform the tests under standardized conditions. Testing was performed in private exam rooms in the Duke Eye Center with the participant and test administrator seated across from each other. The tests were completed on the day of enrollment, before or after the participant's appointment in the LVR clinic. None of the tests contained items that require visual ability (e.g., drawing, writing, object recognition).

The TICS-m was chosen as the screen for cognitive impairment because it is a well-validated measure of global cognitive function that does not rely on visual ability (Brandt and Folstein, 1988; Gallo and Breitner, 1995; Ferrucci et al., 1998) and scores are not influenced by visual loss in older populations (Mangione et al., 1993). Scores were adjusted per protocol based on the participant's educational level (five points added if less than 8 years of education, 2 points added if 8–10 years of education, 2 points subtracted if 16 or more years of education) (Breitner et al., 1995). Consistent with previous work, the screen was considered positive for cognitive impairment if the education-adjusted TICS-m score was 27 or less (Gallo and Breitner, 1995; Chodosh et al., 2004).

Although it provides a reliable measure of global cognitive function, the TICS-m does not fully assess certain cognitive domains which are likely important for successful LVR, including executive function and contextual memory (Crooks et al., 2006). To better assess these domains, the following tests were administered to each participant: Wechsler memory scale-revised (WMS-R), logical memory I (immediate) and II (delayed) (The Psychological Corporation, 1997; Lucas et al., 2005), WMS-R digit span forward and backwards (The Psychological Corporation, 1997), and letter fluency (FAS) (Spreen, 1977). Logical memory is a test of contextual memory, digit span and FAS test executive function, and FAS further tests verbal fluency. A participant's performance on each of these tests was compared to published, demographic normative data, which are widely used in clinical settings (Ivnik et al., 1992; Heaton et al., 2001). Normative data for digit span scores are stratified by age (Ivnik et al., 1992), logical memory normative data are stratified by age and race (Ivnik et al., 1992), and FAS normative data are stratified by age, race, education level, gender (Heaton et al., 2001). For each test, a participant's score was compared to the reported mean score and standard deviation within his or her demographic stratum.

2.4. Demographic and psychosocial data

Race, education level, marital status, and living status were assessed by self report. The patient's age and sex were obtained from the medical chart. A 15-item version of the geriatric depression scale (GDS) (Yesavage et al., 1982) was administered to each participant.

2.5. Analysis

Univariate statistics were used to describe the cohort with respect to demographics and cognitive test performance. The proportion of participants with TICS-m scores at or below the cognitive impairment cut-off (27 or less) and the proportion of participants with marginal TICS-m scores (28–30) are reported. On the other cognitive tests, the proportion of participants scoring at least one or at least two standard deviations below their demographic mean is reported. The binomial test was used to compare the observed proportions to the expected proportions of participants scoring one standard deviation or two standard deviations below a population mean. The binomial test assumed that any participant had a 16.7% chance of scoring one standard deviation below his demographic mean and a 2.5% chance of scoring two standard deviations below the mean. The difference between observed and expected proportions was considered statistically significant if the chance of observing as many or more participants in a given range of test performance was less than or equal to 5% ($p \leq 0.05$).