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Research Report

Visual Acuity Assessment in Persons with Dementia

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Dementia is the most common cause of disability among the elderly. Each year about 1% of those aged 65 and older—more than 250,000 Americans—develop dementia. Incidence rates for Alzheimer's disease increase from 2.8 per 1,000 person-years for those age 65–69 to 56.1 per 1,000 person-years for those over age 90 (Kukull, Higdon, Bowen, McCormick, Teri, Schellenberg, van Belle, Jolley, & Larson, 2002). Alzheimer's disease, by far the most prevalent type of dementia, is characterized by a general decline in intellectual functioning, a progressive decline in memory, impairment in

judgment and abstract thinking, and a change in personality (McKann et al., 1984). The prevalence of dementia increases markedly with age. Dementia is estimated to affect 10% of all those aged 65 and more than 50% of those aged 85 and older, including residents of long-term-care facilities. More than 4 million people in the United States are estimated to have dementia (Cross & Gurland, 1986).

Alzheimer's disease is characterized by mild objective memory deficit in the early stages and progresses to more advanced memory loss, a change in personality, severe limitation in communication, and, ultimately, to complete unawareness of the environment in the later stages (Seltzer, Larkin, & Fabiszewski, 1998). Neuropathological changes in the visual cortex of persons with dementia, resulting in changes in visual function, have been documented (Bassi, Solomon, & Young, 1993; Uhlman, Larson, Koepsell, Rees, & Duckert, 1991). Alzheimer's disease appears to affect the primary visual pathway and may present as an undetected characteristic pattern of visual deficit (Bassi & Sadun, 1990; Hinton, Sadun, Blanks, & Miller, 1986). Persons with Alzheimer's disease demonstrate both widespread axonal degeneration and deterioration of the retinal ganglion cell (RGC). The resulting loss of visual function adds to the morbidity of the disease.

Neurofibrillary tangles and amyloid plaque are markers of Alzheimer's disease (Mendola, Cronin-Golomb, Corkin, & Growdon, 1995). Multiple neurological

substrata are affected in Alzheimer's disease, and the degree of vision loss would seem to be progressive with the advancement of the disease. However, this possibility remains uncertain because of methodological considerations—particularly differences in testing methods and criteria—in the assessment of dementia, as well as in the assessment of vision and the inability to differentiate adequately deficits in the performance of visual tasks from deficits in visual processing. Both persons who are blind and those with dementia have reduced amounts of myelin in the visual cortex, suggesting that because the degree of mylenization may be dependent on stimuli, persons with dementia may have unrecognized visual impairments (Sholtz, Swettenham, Brown, & Mann, 1981).

Performance on measures of visual acuity is affected by cognitive state. A person's cognitive function may be impaired as a result of aphasia, an impairment of expressive or receptive language skills that is usually due to lesions of the left frontal and temporal lobes (Dixon, Trexler & Layton, 1993), or stroke, which may result in the loss of cognitive functioning, as well as losses of visual acuity, visual field, and contrast sensitivity. Brain lesions, such as those that affect the angular gyrus, produce alexia—a visual aphasia in which a person is unable to understand the meaning of written words—coupled with agraphia, the inability to write, with such persons retaining only recognition of isolated letters or numbers (Higgins, 1984); dementia;

and the inability to perform visual tasks that is at least partly due to the severity or level of the dementia.

Visual complaints are common among elderly persons, even in the absence of objective clinical findings of vision loss (Sadun, Borchert, DeVita, Hindon, & Bassi, 1987), the most common complaint being problems in visuospatial functioning (Cogan, 1985; Neary & Snowden, 1987). The prevalence of both dementia and visual pathology increases with age (Morse & Friedman, 1986), and the prevalence of severe visual impairment (that is, blindness or low vision) increases from 14.3% for those aged 65–74 to 27.5% for those aged 85 and older (National Center for Health Statistics, 1989). The degree of visual impairment among persons with dementia may be greater than in the general population as a result of the pathology of dementia.

Vision plays a critical role in many cognitive tasks that affect functional ability and status (Cummings et al., 1995). Visual dysfunction may contribute greatly to disability in persons with Alzheimer's disease and may exacerbate the effects of other types of cognitive loss that accompany the disease (Mendez, Tomsak, & Remler, 1990). Given their diminished cognitive reserve, persons with dementia are particularly vulnerable to additional cognitive dysfunction resulting from comorbid conditions, such as visual impairment, which may contribute to cognitive dysfunction in persons with Alzheimer's disease by increasing

disorientation and impairing learning and may contribute to the increased severity of the symptoms of Alzheimer's disease (Uhlman et al., 1991).

The nature and extent of visual impairment in persons with Alzheimer's disease is not yet understood. Visual function is fragile and susceptible to disturbance from normal events, such as aging, as well as from pathological processes. Dementia and other cerebrovascular events that affect the brain and related structures may further disturb or interfere with vision, and the resulting loss of visual function adds to the morbidity of the disease. Conventional protocols to assess visual function may be inadequate for persons with dementia.

Although much is known about vision and visual mechanisms in persons with dementia, a more complete understanding could help reduce the excess disability that may be attributable to visual impairment, rather than to deficits in visual processing, in such persons. Vision care should be one of the cornerstones of effective and comprehensive care for aged patients. Although some sensory loss may accompany aging, its role as a determinant of a person's functioning is often overlooked. Because of the importance of vision to everyday functioning, data on visual performance are particularly useful in planning patients' care.

Method

The sample for this study consisted of persons who were selected randomly from 11 metropolitan New York City long-term-care facilities and constituted a probability sample of 500. The sample had a mean age of 84.97 years (*SD* = 9.21); 23% were men and 77% were women.

Most studies of vision in persons with Alzheimer's disease either exclude those with advanced dementia or are unable to assess their vision adequately, and, therefore, we believe, improperly report these persons' visual acuity status. In this study, visual acuity was assessed using the ETDRS Snellen-type acuity chart and Teller Acuity Cards, by Vistech Consultants (see Figure 1). The Teller Acuity Cards were used only after the participants were unable to respond appropriately to the ETDRS, which in most studies would be a basis for excluding such persons or misreporting their visual acuity. The cards were developed to evaluate vision in infants but have been applied to other nonverbal persons, including elderly people with dementia (Marx, Werner, Cohen-Mansfield, and Hartman, 1990).

Using a forced-choice, preferential looking approach, Teller Acuity Cards, with a visual grating of known and precise bandwidths, are presented in any order to determine the finest grating that can be perceived. After we pilot tested the protocol, the test distance for this elderly group was reduced from 3 meters (9 feet, 10 inches) to 1 meter (3 feet, 3 inches) to facilitate the

test(s administration. For the purposes of analysis, visual acuity was grouped into five categories: normal visual impairment (20/20–20/40), mild visual impairment (20/50–27/70), moderate visual impairment (20/80–20/200), severe visual impairment (20/250–20/1000), and very severe visual impairment (counting fingers, hand motion, or no light perception).

Each participant was assessed for cognitive impairment using the Global Deterioration Scale (GDS), a 7-point instrument that was designed to assess the degree of cognitive and functional capacity that is widely used in the staging of dementia (Reisberg, Ferris, deLeon, & Crook, 1982). For the purposes of this study, data on the GDS scores were grouped into four categories: mild, moderate, severe, and very severe dementia. The behavioral descriptions of the grouped dementia ratings are presented in Box 1.

Results

The Teller Acuity Cards are a useful method of assessing visual acuity in older persons with dementia. This procedure contributed additional data beyond what would have been obtainable using conventional Snellen-type eye charts. Of the 81 participants with severe dementia, data on acuity could be obtained for 61 using the Teller cards, compared with 47 using the ETDRS chart. Of the 48 participants with very severe dementia, data on acuity could be obtained for 20 patients using the Teller cards, compared with 10 using

the ETDRS. A comparison of usable data on acuity obtained using the Teller cards and the ETDRS is presented in Table 1. Overall, in the subset of 391 patients for whom data were available, 28% had vision in the normal range; 17% were mildly visually impaired; 23% were moderately visually impaired; 12% were severely visually impaired; 1% were very severely visually impaired; and 19% were untestable, even with the Teller cards because of their level of dementia. Data on visual acuity, by level of dementia, are presented in Table 2.

Discussion

This study yielded additional data on visual acuity in a population of elderly persons for whom visual acuity has not previously been well documented. Our results present estimates of visual acuity by level of dementia and data on prevalence for a population of elderly persons, including those at all stages of dementia.

Traditional vision examinations emphasize ocular disease and, in terms of visual function, commonly report acuity as well as visual fields. Measures of acuity and visual fields provide data about one specific visual function under a specific set of controlled conditions, but they do not provide data about how a person uses visual information. Moreover, conventional protocols are inadequate for assessing visual acuity in persons with dementia. Cognitive impairments, including deficits in language,

comprehension, and memory, can interfere with the performance of visual tasks. In addition, basic visual deficits may affect tests of more complex visual functioning. Complaints of visual problems by persons with dementia are both common and real. Furthermore, persons with Alzheimer's disease may be presumed to have normal age-related vision changes, as well as oculomotor disturbance and visual dysfunction as a result of Alzheimer's disease. The loss of cognitive function and the inability to communicate with the examiner makes any assessment of their vision difficult. It is important to consider any technique that may yield usable data.

Although we are able to report more accurately on the visual acuities of a population with dementia, we cannot shed additional light on how these persons process visual information. Two persons with identical acuities may function differently on the basis of individual and environmental variables. While important, therefore, these measures focus on the degree of impairment, rather than on the extent to which visual function is present and, what is more important, usable. The loss of functional vision, so common in an aging population, is often considered a normal part of the aging process, and no treatment, correction, or improvement is believed possible. Practitioners, family members, and older persons themselves are equally guilty of harboring this erroneous belief. Institutions have a special responsibility to treat ocular disorders properly and to

optimize usable vision and visual functioning.

Because many residents of continuing care facilities, such as those with known and significant levels of dementia or with aphasia, are unable to give accurate responses as a result of impaired cognitive functioning, creative approaches to assessment are particularly useful for this population. Because of the importance of visual functioning in the daily lives of these residents, techniques such as the use of Teller Acuity Cards should be utilized whenever there is reason to doubt the accuracy of more conventional measures or the residents are unable to respond appropriately to an examiner's questions.

This study has demonstrated that assessments of visual acuity with Snellen-type protocols, such as the ETDRS, are generally inadequate for assessing visual acuity in persons with dementia and that Teller Acuity Cards are useful for this purpose after the use of ETDRS is no longer possible. Moreover, the utility of both methods declines as the level of dementia increases. The ability to assess the visual acuity of persons with dementia will contribute to a more precise determination of the prevalence of visual impairment in elderly people. Commonly, persons with dementia are excluded from studies and are not accurately reported in the epidemiological literature because they are unable to respond to traditional methods of visual assessment. Although an evaluation of the loss of or dysfunction in neural cells as a result of dementia is

beyond the scope of this article, such information may help to further explain vision loss in aging, and an understanding of the causes of neural cell loss or dysfunction may be helpful in designing remedial interventions or treatments and in assigning appropriate staff to address residents' needs adequately. There is also an ongoing need to educate staff about vision loss and the complex behaviors that may result from a combination of vision loss and dementia.

Persons with dementia have normal age-related vision changes and visual dysfunction as a result of dementia. Although sensory loss is well known as a concomitant of aging, its role as a determinant of functioning is often overlooked. Persons with cognitive impairments suffer from deficits in processing. How much greater is their impairment as a result of a deficit in sensory (that is, visual) input? Clearly, visual impairment contributes to excess morbidity in persons with Alzheimer's disease and other cognitive impairments, but the degree and nature of the contribution remain unclear. Adequate and appropriate assessment of vision is a first step toward understanding the role played by vision in the functioning of persons with cognitive impairments. Future research is needed to elucidate the contribution of vision loss to behavioral dysfunction in persons with Alzheimer's disease and other forms of dementia.

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