Optometric Perspective of Alzheimer's Disease

Maryke N. Neiberg, O.D.
Southern College of Optometry
Memphis, TN

Abstract

Alzheimer's disease is not a normal part of ageing. Rather, it is a devastating disease that has far reaching implications for both the patient and the family of the patient. A variant of Alzheimer's disease affects visual skills, visuomotor and visuospatial ability before it causes the dementia we ordinarily associate with Alzheimer's disease. Optometrists may have the ability to detect this variant in our patients earlier in the course of the disease. Earlier detection allows earlier intervention, psychological adjustment and appropriate treatment. Optometrists, in addition to earlier detection, may also play a role in developing strategies and coping skills through assistance with visual needs and the rehabilitation of visuo-motor, visual memory and visuospatial skills of these patients. This review describes the clinical implications of the visual variant of Alzheimer's disease and explores strategies for care.

Key Words

Alzheimer's disease, posterior cortical atrophy, vision, visual agnosia, visual skills, visual variant of Alzheimer's disease

Neiberg MN. Optometric perspective of Alzheimer's disease. J Behav Optom 2009;20:3-6.

Older individuals complain from time to time about "senior moments," or "old timer's disease" when they can't remember something or misplace an item. In older people these functional changes are mainly caused by the deterioration of the brain's frontal areas.[1] Alzheimer's disease (AD) is a group of brain conditions that cause destruction of brain tissue and in advanced stages, develop fibril plaques in brain tissue. The earliest stages of AD may initially seem similar to age related memory change, and may not appear serious enough for concern.[2] Moderate stage AD affects and interferes with daily activities, cognition, and memory. Late stage AD may be so devastating that it requires total care of the patient.

The onset of Alzheimer's late in life is more common than its early onset. The disease has no known inheritance or familial factors.[2] However, a possibly inherited autosomal dominant form of early onset AD is characterized by the onset of the disease prior to age 60.[3] In typical AD, the incidence increases with advancing age and doubles every five years beyond age 65.[3] It is estimated that 4.5 million Americans suffer from AD.[2]

The Visual Variant of Alzheimer's Disease

The visual variant of Alzheimer's disease (VVAD), is also known as posterior cortical atrophy, because of the more posterior shifting of the disease in the brain.[4] Visuo-spatial impairment and visual disturbances may precede the manifestations of dementia and clinical onset of AD.[5,6] These patients may have difficulty with visual fields, color vision, cognitive/memory factors and contour integration. They also have trouble perceptually linking together similarly oriented line elements hidden between randomly oriented distracters.[7,8] For instance, problems with the Ishihara test, despite normal color vision, may indicate difficulty with contour integration.[9]

In early cases, language, insight and judgment are spared with only mild memory impairment. Patients with visual deficits may be aware of, and be distressed by, them. This may, in turn, lead to mental depression.[4] Patients may complain of difficulty with reading tasks that they ascribe to their glasses. Basic near acuity declines faster in patients with AD, but difficulty reading (alexia) and difficulty writing (agraphia) are common additional features of the VVAD.[10,11] Visuo-spatial and form identification skills tests can be effectively used to differentiate basic visual difficulties versus the VVAD. Standardized clock drawing is sometimes used as a simple screening tool. The patient is instructed to draw a clock face with numbers and clock hands indicating the time.[10] Patients with disordered visuospatial relationships will have difficulty executing this task, being unable to locate the clock hours at their appropriate positions.

The Wechsler Adult Intelligence Scale-Revised does not differentiate the VVAD and visually asymptomatic AD patients. If the visuo-spatial difficulties are suspected to be due to VVAD, patients are better screened with tests designed to specifically test for visual-spatial functioning.[12]

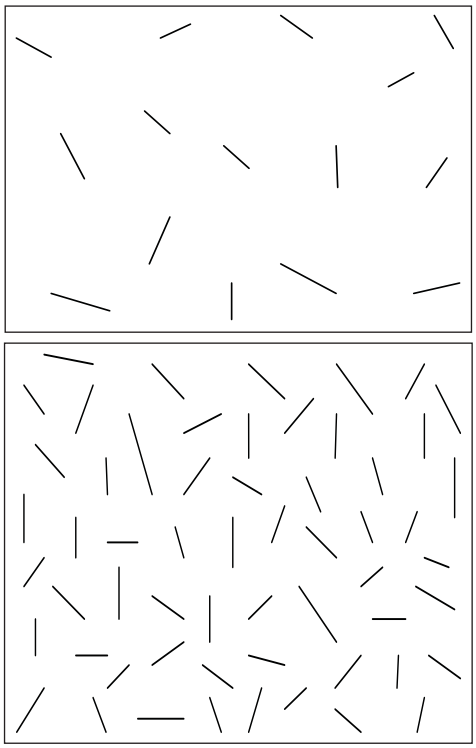

Figure 1. Depiction of a low-density line cancellation test (top figure).[13] Subjects are asked to cross out all the lines. The score is based on the time it takes and the number of lines left uncrossed. High density line cancellation is depicted on the bottom. It is scored similarly to the low-density cancellation test.

Trobe and Butler suggest a 16-item, multiple choice battery (Benton Form Discrimination Test)[a] consisting of three form identification tests and four visuo-spatial tests. They use overlapping forms, masked forms and fragmented forms, to construct the form identification section. The visuo-spatial aspect uses low density line cancellation, high density line cancellation, reading and puzzle construction tasks.[13] Examples of these tests are depicted in Figure 1. Patients with VVAD score consistently lower on these tests. This visuo-spatial disorganization inevitably forces patients to abandon their independent living functions, especially driving.

Reading ability in patients with AD may be further complicated by a type of crowding phenomenon, a very early symptom of posterior cortical atrophy. This is similar to the crowding phenomenon seen in amblyopia.[14] In the initial stages of the disease the patients present with difficulty seeing static objects and have unstable fixation, but retain vision of moving objects.[15,16] Most of what we traditionally read requires stable fixation of static objects (symbols). It might be possible to improve reading comprehension, at least in the early stages, by using a moving target, such as a ticker tape. Taking basic acuity could be made easier by using kinetic letters. An example of this type of acuity stimulus might be the headline news as it moves across the bottom of the television screen.

As the disease progresses, difficulties recognizing familiar objects (visual agnosia) emerge and advance. Tactile recognition usually remains intact.[4] Other symptoms may include decreased stereopsis, prolonged saccadic initiation, saccadic dysmetria and difficulty with figure copying tasks.[10,15,16] Signs may often include reduced low frequency contrast sensitivity impairment. Global processing of information (figure-ground and closure) is also impaired in patients with the VVAD.[4] Distance visual acuity, glare disability and motion declines at the same rate as individuals without AD.[11]

Visual Field Defects

Visual field defects are not commonly seen in the early stages of the disease, but a general loss of sensitivity is almost universally present.[17,18] Some investigators believe that in addition to cortical damage, there is damage to the optic nerve.[17] Formal visual field testing is challenging to a patient with AD and poor fixation is but one of the culprits. Homonymous or para-central homonymous visual field defects are often present later in the disease progression.[10]The inferior field may be affected. Severe degeneration of the right primary visual cortex, for instance, may present with left homonymous hemianopsia and macular sparing. It may mimic the findings of infarction or hemorrhage. These are best differentiated by brain imaging, such as Magnetic Resonance Imaging (MRI).[19] In addition to visual field loss, there may be hemi-inattention or hemispatial neglect.[4] Pattern visual evoked potentials show an increased latency, indicating dysfunction between the striate cortex, visual associative structures and the temporo-parietal-occipital visual analyzers.[20]

Considerations of Functional Vision

VVAD may demonstrate an acquired dyslexia. Dyslexia is known to have, amongst other factors, a magno-cellular dysfunction.[16,20] In the acquired dyslexia of VVAD, the reader is exquisitely sensitive to a critical print size, requiring a particular larger print size to reach maximum reading speed.[21] The larger print size may serve to reduce the crowding

phenomenon, produce fewer letters in a single glance and thereby improve visual attention. A magnocellular-cell deficit produces a poor signal to the superior colliculus, causing prolonged saccadic initiation and saccadic dysmetria. Both of these signs are seen in dyslexia and VVAD.[18] In the early stages of the VVAD the patient's reading ability may benefit in a way similar to dylexia by increasing the print size to the critical print size factor that requires fewer saccades.[21] Sakai et al found that wearing yellow glasses improved contrast sensitivity and subjective comfort in their patient with the VVAD and this may have relevant optometric clinical applications.[22]

Memory and Cognition

Poor visual memory is an early expression of the disease and may indicate an opportunity for early intervention.[21] Likewise, multiple errors on the Benton Visual Retention test may predict an increased risk of AD up to 15 years prior to onset of dementia.[17]

The implication of these early diagnostic tests are encouraging. It affords occasion for the early detection and therefore early referral. It will allow intervention with prophylactic drug therapy as well as participation in further research. Early detection, most importantly, allows the patient and his family time to plan and reduce the impact of the disease. In addition, the patient may seek assistance to improve visuospatial, visual-perceptual and visual memory skills. This may be accomplished in a more structured way through lenses, prisms and visual therapy. The goal should be to attempt to delay the effects of the disease and to develop coping strategies that engage some lesser affected facilities, such as the tactile sense. Optometrists already engaged in vision therapy may be perfectly aligned to step into this role. Regular visual memory screening for every patient at age 50 or older, and regularly thereafter, should a priority in preventative care.

Management Considerations for AD and VVAD

There is no single treatment or cure for AD. Research in the area is vigorous and several important discoveries have been made, both in proving the efficacy of treatment or debunking myths about the disease. In general, a higher level of education, better socio-economic status, limb length (related to nutrition) and head circumference (brain development) seem to protect against dementia.[23] The most effective medical therapy seems to be combination drug therapy using cholinesterase inhibitors and Memantine HCl.[24,25] A recent study showed that use of statins decreased the risk of dementia by as much as 50%.[26] The non-steroidal anti inflammatory drugs show promise in effectively lowering the risk of AD.[27] The use of selective serotonin re-uptake inhibitors and risperidone is effective in controlling the additional symptoms of agitation and hallucinations experienced by some patients.[28,29]

We could advise our patients that certain lifestyle changes may reduce the risk of AD.[30] Reducing stress hormones; exercise, lowering cholesterol in middle age and reducing abdominal fat are helpful in this regard.[30-32] Controlling hypertension in midlife and diabetes later in life significantly reduce the risk of dementia.[33]

Ginko biloba was found not to improve memory, but the use of an anti-epileptic and mood stabilizing drug, valproic acid, showed promise in terms of memory loss reversal in some patients. This drug is currently used off label for this purpose and is not yet recommended for general use.[29,34,35] Increasing Omega 3 and 6 fatty acid intake may also reduce the risk.[36] A recent mouse model study suggests that moderate consumption of red wine may reduce the incidence of AD. It may also have a protective effect against the disease.[37] The beneficial agent was administered in the form of commercially available supplement of grape derived polyphenols.

Though not universally embraced, brain exercises (as in visuo-cognitive therapies) may serve to protect from dementia.[38] We may design therapeutic tasks to target the particular skills at risk in VVAD by utilizing larger cortical areas and using integrated functioning strategies such as coordinated tactile and visual assimilation.

CONCLUSION

AD is not a normal part of ageing. It is a devastating disease that has far reaching implications for the patient and the family of the patient. A variant of AD affects visual skills, visuo-motor and visuo-spatial ability long before it causes the dementia we ordinarily associate with AD. This variant causes visual symptoms that are disturbing to the patient, affecting life and independence even before dementia sets in. Optometrists have the capability to detect AD at an early stage along with VVAD. This could provide early diagnosis and appropriate treatment. Optometrists may also play a role in developing strategies and coping skills through assistance and rehabilitation of these patients. Optometrists have the tools to diagnose the disease and can act as gatekeeper in the multidisciplinary approach to care.

Source

a. Benton Visual Form Discrimination Test
WW-4877KT.
PAR Inc. 16130 N Florida Avenue
Lutz, FL 33549

References

1. Desgranges B, Kalpouzos G, Eustache F. Cerebral imaging in ageing: contrast with Alzheimer's disease. Rev Neurol (Paris) 2008;164 suppl 3:S102-7 .
2. Alzheimer's disease Fact Sheet. www.nia.nih.gov/Alzheimers/Publications/adfact.htm. Accessed February 14, 2009.
3. Guyant-Marechal L, Campion D, Hannequin D. Alzheimer disease: Autosomal dominant forms. Rev neurol (Paris) 2008 (epub ahead of print). Last accessed December 9, 2008.
4. Mendez, M. Posterior cortical atrophy: A visual variant of Alzheimer's disease. In: Cronin-Golomb A, Hof PR, eds. Vision in Alzheimer's Disease. Interdiscipl Top Gerontol. Basel, Karger, 2004;34:112-25.
5. Mapstone M, Steffenella TM, Duffy CJ. A visuospatial variant of mild cognitive impairment: getting lost between ageing and AD. Neurol 2003;60:802-08.
6. Cogan DG. Visual disturbances with focal progressing dementing disease. Am J Ophthalmol 1985;100:68-72.
7. Uhlhaas PJ, Pantel J, Lanfermann H, Prvulovic D, et al. Visual perceptual organization deficits in Alzheimer's dementia. Dement Geriatr Cogn Disord 2008;25:465-75. Epub 2008. Accessed April 11, 2008.
8. Mathes B, Fahle M. The electrophysiological correlate of contour integration is similar for color and luminance mechanisms. Psychophysiol 2007;44:305-22.
9. Brazis PW, Graff-Radford NR, Newman NJ, Lee AG. Ishihara color plates as a test for simultanagnosia. Am J Ophthalmol 1998;126:850-51.
10. Lee AG, Martin CO. Neuro-ophthalmic findings in the visual variant of Alzheimer's disease. Ophthalmol 2004;111:376-80.
11. Rizzo M, Dawson JD, Ergun YU, Anderson S, et al. Relative rates of visual and cognitive decline in Alzheimer's disease. J Vis 2006;6:967,967a.
12. Trobe JD, Butter CM. Foster NL, Berent S. Visual-spatial deficits explain visual symptoms in Alzheimer's disease. Am J Ophthalmol 1996;122:97-105.
13. Trobe JD, Butter CM. A screening test for integrative visual dysfunction in Alzheimer's disease. Arch Ophthalmol 1993;111:815-18.
14. Crutch SJ, Warrington EK. Foveal crowding in posterior cortical atrophy: A specific early-visual-processing deficit affecting word reading. Cogn Neuropsychol 2007;24:843-66.
15. Midorikawa A, Nakamura K, Nagao T, Kawamura M. Residual perception of moving objects; dissociation of moving and static objects in a case of posterior cortical atrophy. Eur Neurol 2008;59:152-58. Epub 2008. Last accessed January 29, 2009.
16. Kiwosawa M, Bolsley TM. Chawluk J, Jamieson D, et al. Alzheimer's disease with prominent

visual symptoms. Clinical and metabolic evaluation. Ophthalmol 1989;96:1077-86.
17. Sato M, Meguro K, Ishizaki J, Ishii H, et al. Early detection of patients with Alzheimer's disease with the Benton Visual Form Discrimination Test. Japanese J Neuropsychol 2001;17:62-68.
18. Katz B, Rimmer S. Ophthalmic manifestations of Alzheimer's disease. Surv Ophthalmol 1989;34:31-42.
19. Oda H, Ohkawa S, Maedea K. Hemispatial visual defect in Alzheimer's disease. Neurocase 2008;14:141-46.
20. Galaburda AM, Livingstone MS. Evidence for a magnocellular defect in developmental dyslexia. In: Talla P, Galaburda AM, Llinas RR, von Euler C, eds. Temporal information processing in the nervous system. Anals of the New York Academy of Sciences 1993;682:70-82.
21. O'Brien BA, Mansfield JS, Legge GE. The effect of print size on reading speed in dyslexia. J Res Read 2005;28:332-49.
22. Sakai S, Hirayama K, Iwasaki S, Fujii T, et al. Yellow glases improve contrast sensitivity of a patient with a visual variant of Alzheimer's disease. Eu Neurol 2002;48:224-25.
23. Kim JM, Stewart R, Shin IS, Kim SW, et al. Associations between head circumference, leg length and dementia in a Korean population. Int J Geriatr Psychiatry 2008 ;23:41-48.
24. Atri A, Shaughnessy LW, Locascio JJ, Grwdon JH. Long-term course and effectiveness of combination therapy in Alzheimer disease. Alzheimer Dis Assoc Disord 2008;22:209-21.
25. Hermann N, Lancot KL. Pharmacologic management of neuropsychiatric symptoms of Alzheimer disease. Can J Psychiatry 2007;52:630-46.
26. Caballero J, Hitchcock M, Beversdorf D, Scharre D, et al. Long-term effects of anti-depressants on cognition in patients with Alzheimer's disease. J Clin Pharm Ther 2006;31:593-98.
27. Szekely CA, Thorne JE, Zandi PP, Ek M, et al. Nonsteroidal anti-inflammatory drugs for the prevention of Alzheimer's disease: a systematic review. Neuroepidemiol 2004;23:159-69.
28. Cramer C, Haan MN, Galea S, Ek M, et al. Use of statins and incidence of dementia and cognitive impairment without dementia in a cohort study. Neurol 2008;71:344-50.
29. Satvat E, Mallet PE. Chronic administration of a Ginkgo biloba leaf extract facilitates acquisition but not performance of a working memory task. Psychopharmacol (Berl) 2008 [Epub ahead of print]. Last accessed December 9, 2008.
30. Green KN, Steffan JS, Martinez-Coria H, Sun X, et al. Nicotinamide restores cognition in Alzheimer's disease transgenic mice via a mechanism involving sirtuin inhibition and selective reduction of Thr231-phosphotau. J Neurosci 2008;28:11500-510.
31. Solomon A, Kareholt I, Ngandu T. Serum cholesterol changes after midlife and late-life cognition: twenty-one-year follow-up study. Neurol 2007;68:751-56.
32. Kivipelto M, Solomon A. Alzheimer's disease-the ways of prevention. J Nutr Heath Aging 2008;12:89-94.
33. Kloppenborg RP, van den Berg E, Kappelle LJ, Biessels GJ. Diabetes and the vascular risk factors for dementia: Which factor matters most? A systematic review. Eur J Pharmacol 2008;585:97-108.
34. Dodge HH, Zitzelberger T, Oken BS, Howieson D, et al. A randomized placebo-controlled trial of Ginkgo biloba for the prevention of cognitive decline.<http://www.ncbi.nlm.nih.gov/pubmed/18305231?ordinalpos=4&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum> Neurology. 2008 May 6;70(19 Pt 2):1809-17. Epub 2008 Feb 27.
35. Konavalov S, Muralee S, Tampi RR. Anticonvulsants for the treatment of behavioural and pscychological symptoms of dementia: a literature review. Int Psychogeriatr 2008;20:293-308.
36. Das UN. Essential fatty acids and their metabolites could function as endogenous HMG-CoA reductase and ACE enzyme inhibitors, anti-arrhythmic, anti-hypertensive, anti-atherosclerotic, anti-inflammatory, cytoprotective, and cardioprotective molecules.<http://www.ncbi.nlm.nih.gov/pubmed/18922179?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum> Lipids Health Dis. 2008 Oct 15;7:37.
37. Ono K, Condron MM, Ho L, Wang J, et al. Effects of grape seed-derived polyphenols on amyloid {beta}-protein self-assembly and cytotoxicity. J Biol Chem 2008;283:32176-87.
38. Sorell JM. Remembering: forget about forgetting and train your brain instead. J Psychosoc Nurs Ment Health Serv 2008;46:25-27.

Corresponding author:
Maryke N. Neiberg O.D., FAAO
Southern College of Optometry
1245 Madison Ave
Memphis, TN 38104
Mneiberg@sco.edu
Date accepted for publication:
January 22, 2009