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REVIEW

Mobility and safety issues in drivers with dementia

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ABSTRACT

Although automobiles remain the mobility method of choice for older adults, late-life cognitive impairment and progressive dementia will eventually impair the ability to meet transport needs of any. There is, however, no commonly utilized method of assessing dementia severity in relation to driving, no consensus on the specific types of assessments that should be applied to older drivers with cognitive impairment, and no gold standard for determining driving fitness or approaching loss of mobility and subsequent counseling. Yet, clinicians are often called upon by patients, their families, health professionals, and driver licensing authorities to assess their patients’ fitness-to-drive and to make recommendations about driving privileges. We summarize the literature on dementia and driving, discuss evidence-based assessments of fitness-to-drive, and outline the important ethical and legal concerns. We address the role of physician assessment, referral to neuropsychology, functional screens, dementia severity tools, driving evaluation clinics, and driver licensing authority referrals that may assist clinicians with an evaluation. Finally, we discuss mobility counseling (e.g., exploration of transportation alternatives) since health professionals need to address this important issue for older adults who lose the ability to drive. The application of a comprehensive, interdisciplinary approach to the older driver with cognitive impairment will have the best opportunity to enhance our patients’ social connectedness and quality of life, while meeting their psychological and medical needs and maintaining personal and public safety.

Keywords: older adult, dementia, Alzheimer’s disease, cognitive impairment, driving, automobile, transportation, assessment

Introduction

Driving is the most important method of transportation for adults across the lifespan. In 2009, there were 33 million licensed drivers over the age of 65 years in the US (USD Department of Transportation, 2010) and 40,000,000 drivers over age of 70 years in the UK (BBC News, September 2013). Progressive disease that impairs driving in older adults has at least two serious adverse outcomes: injury or death from a motor vehicle accident (MVA) or driving cessation. However, older drivers are the safest demographic group in terms of crashes per year and older drivers with medical conditions relevant to driving are also safer than younger groups with medical conditions relevant to driving (Redelmeier et al., 2012; Papa et al., 2014). This occurs despite higher levels of multimorbidity, and points to factors in addition to reduced exposure as yet inadequately described such as prudence and wisdom, which may mediate the impact of multiple illnesses on driver safety. However, older adults aged 70–74 years will be dependent on alternative sources of transportation for about seven years and for women about 10 years after stopping driving (Foley et al., 2002). Sharp declines in health have been associated with loss of mobility in older adults (Edwards et al., 2009). The US due to its size and rural geographic areas makes transportation options for older adults especially challenging when compared to European countries that may have more developed and cost-effective public transportation systems. Thus, developed countries will be increasingly faced with an increased transportation burden and need from their elders.

Dementia and specifically common neurodegenerative diseases such as Alzheimer’s disease (AD) likely contribute to both issues of traffic safety and loss of mobility. Perhaps, 4% of current drivers over age 75 years have a dementia (Foley et al., 2000) and many of older adults continue to drive well into the disease process (C denheim er, 1993). In a study where older adults were administered a well-validated brief cognitive screen to detect dementia (e.g., the Short Blessed Test) (Katzman et al., 1983),
nearly 20% of those over age 80 years failed (Stutts et al., 1998). The province of Ontario in Canada estimates that they will have over 100,000 drivers with dementia on the road by 2004 (Hopkins et al., 2004). These studies probably underestimate the actual number of drivers with dementia on the road, since some older adults with memory loss continue to drive even after they are reported to have stopped or even if they fail to renew their licenses.

In this review, we present an evidenced-based approach to the evaluation, assessment, and counseling of older drivers with cognitive impairment in pain ent. We review studies that have examined functional abilities and traffic skills in drivers with dementia, identify co-morbidities that can further reduce driving competence, examine options for driving evaluation, and finally, discuss key aspects of mobility counseling to inform patients of transportation alternatives.

Definitions

Mild cognitive impairment (MCI) (term ed "mild neurocognitive disorder" under the DSM-5 classification) is a syndrome defined by one or more abnormalities in a specific cognitive domain (e.g., memory, executive function), a deviation from the norm on a standardized psychometric test related to the same, and usually the absence of significant impairment in daily activities (Albert et al., 2011). Two preliminary studies indicate there may be possible impairments in daily living skills MCI (Pfeffer et al., 2009). However, one study combined dementia and MCI together, which makes interpretation of the analysis difficult and the results showed less than optimal performance rather than severe impairment in MCI. More research is needed on MCI. The diagnosis requires some waiver controversial since definitions may vary as to what level of intact or very mild functional impairment in pain ent is allowed, if at all. In addition, many patients obviously fit a phenotype of early AD, even if they do not yet have definite functional impairment in pain ent.

In contrast, dementia (term ed "m ajor neurocognitive disorder" under the DSM-5 classification) is manifested by the onset of impairment in a specific domain (e.g., memory, executive function), the deficit causes significant impairment in daily living and/or occupational functioning. Formal criteria to diagnose MCI, dementia, and specifically AD have recently been updated (MCKhan et al., 2011) and have now been placed under the category of neurocognitive disorders in the DSM-5 manual (16).

Dementia and driving outcomes

There are two major outcomes of importance in studying the impact of dementia on driving: mobility and safety. It is clear that one of the most devastating consequences of dementia is eventual loss of mobility (driving cessation), and loss of mobility in dementia is associated with a mismatch between transportation needs and available resources. This important issue is discussed later in this paper. One key outcome relevant to driving safety is a crash causing injury or death, but a challenge of this outcome is the relative infrequency of crashes. In general, most studies have documented a 2-5-fold increase in crash rate compared to age-matched controls (>70+ years), although two studies have documented no differences (Carrell et al., 2010).

Performance-based road tests are often used as a measure of driving competence. The majority of studies report on qualitative outcomes (e.g., "pass/fail" rates) in comparison to control, but some studies have tracked specific types of errors (Odenheimer et al., 1994; Hunt et al., 1997). Drivers with dementia have been documented to have particular difficulties with lane checking and changing, merging, left turns, signaling to park, and route following (Akinwuntan et al., 2005). The Clinical Dementia Rating (CDR), a global measure of dementia severity, uses a semi-structured interview and exam to rate the severity of the dementia (Morris, 1993). Pooled data from two longitudinal studies involving a total of 134 individual drivers with dementia (Duchek et al., 2003; Ott et al., 2008b) reveal that 88% of drivers with very mild dementia (CDR = 0.5) and 69% of drivers with mild dementia (CDR = 1.0) were still able to pass a formal road test.

In driving simulation studies, drivers with AD in general perform more poorly than do controls without dementia (Rizzo et al., 2001; Freund et al., 2002) make slower left-hand turns, are more likely to drive off the road, and drive more slowly than the speed limit (Cox et al., 1998). Studies from the National Advanced Driving Simulator at the University of Iowa noted that slow or inappropriate responses were major factors leading to simulator accidents (Rizzo et al., 2001).

The majority of studies on dementia and driving have focused on AD; however, other degenerative dementias are not uncommon and may impact driving fitness. Indeed, pure dementia syndrome are less common in advanced age justifying the
need for more research in this age group (Brayne and D avis, 2012). In a road test study of controls and vascular dementia (VD) and/or AD dementia, driving performance errors were comparable between AD and VD patients (Fitten et al., 1995). Similar to MCI, vascular dementia definitions that are not related to discrete subsequent strokes remain controversial since the m in in al count and location of white matter disease to establish this diagnosis is still unknown. Disinhibited behaviors in patients with frontotemporal lobe dementia (FTD) have been associated with impaired driving (Caselli and Yaari, 2007; de Simone et al., 2007). Lewy body dementia (LBD) patients have prominent visuospatial and attention deficits, underlying psychosis and fluctuating levels of alertness, any of which may impair driving abilities early in the course of the disease. However, we are currently unaware of any specific studies on LBD and driving.

Evaluating mobility and driving safety

A preliminary enquiry to all patients who are being assessed for memory disorders and as to whether or not they drive is an important first step in clarifying the impact of dementia on both mobility and safety. The clinical opinion of a primary care physician or subspecialist, evidence of a recent crash, new onset of impaired driving behaviors noted by caregivers, decline in key cognitive domains (e.g. attention, visuospatial skills), or in palm ent in higher order level (executive function), activities of daily living, impaired driving performance-based evaluations such as road tests, and difficulty with simulator scenarios have all been used in various settings to risk stratify or assess fitness-to-drive in individuals with a dem en ting illness. There is no accepted gold standard for an approach to assessing driving safety, although two recent evidence-based reviews provide clinicians some guidelines based on dem entia and driving studies in the literature (Carr and Ott, 2010; Iverson et al., 2010).

A useful approach for clinicians that are providing fitness-to-drive recommendations in older adults with a dem enting illness should consider the following three steps: (a) confirming a diagnosis and treating reversible causes for cognitive decline (e.g., sleep apnea, discontinuing sedating medications); (b) rating the severity of the dementia; and (c) identifying additional co-morbidities that have the potential to further decrease the ability to operate an automobile. Additional queries could focus on identifying any decrements in driving behavior that have occurred during the course of the dem enting illness, inquire about the new onset of impaired performance in other higher order instrumental activities of daily living which could be a proxy for impaired driving in palm ent, and to document the presence of specific cognitive domains (e.g., attention, visuospatial skill) that have been associated with impaired driving outcomes using psychometric testing.

A thorough evaluation of individuals with dem entia have consistent difficulty in driving situations, many patients early in the course of dem entia are still able to pass a driving performance test and are likely still relatively safe to drive. One caveat that should be considered is that simply having a diagnosis of dem entia should not be the sole justification for the revocation of a driver’s license (Iverson et al., 2010). However, with any new diagnosis of a progressive neurodegenerative dem entia, clinicians should immediately begin a conversation about the inevitability of future driving cessation. This discussion should include mobility counseling (a discussion of transportation alternatives and/or barriers to cessation). These discussions should be repeated with both the patient and caregiver to reduce the possibility of resistance or non-compliance with future recommendations.

Clinician evaluations

Family members have expressed their desire or wish that physicians provide guidance in this area (Perkinson et al., 2005). Thus, the primary care physician or subspecialist may be the only opinion available or acceptable to the patient, caregiver, or community in regards to fitness-to-drive in an older adult with dem entia. In one study, most accurate were clinicians specially trained in dem entia assessment (Ott et al., 2005).

Professional guidelines and consensus statements

Consensus among national medical, transportation, and elder advocacy societies is that drivers with moderately severe dem entia should not drive. Unfortunately, clinicians are rarely taught how to assess dem entia severity and would be hard pressed to quantify or rate patients with a m odestly severe dem entia. The CDR , used more in research than in clinical practice, takes specialized training and often takes 45 min or more to complete, rendering it often in practical form any office settings. Although there are limitations to the use of psychometric testing in assessing dem entia severity, specific scores on global psychometric cognitive screening or specific tests may give useful ranges that could place drivers in “at-risk” categories (see Table 1).

Co-morbidities and medications

The influence of multiple medical illnesses or co-morbidities on further impairing driving ability in
patients with dementia has not been well studied, but should be considered when evaluating driving competency. A comprehensive publication in the past five years summarizes the extensive literature on medical conditions and crash risk (Charlton et al., 2010). However, many medical conditions have not been studied.

Medical conditions that are age-related and associated with impaired driving ability— but which also hold the potential for remediation— include: diseases affecting vision (e.g., macular degeneration, glaucoma, cataracts); cardiovascular diseases (e.g., in plantable defibrillators, arrhythmias); respiratory diseases (e.g., COPD, sleep apnea); neurologic diseases (e.g., AD, multiple sclerosis, stroke, Parkinson disease); psychiatric diseases (e.g., psychosis, anxiety, depression); metabolic diseases (e.g., hyper or hypoglycemia); and musculoskeletal diseases (e.g., cervical arthritis with restrictive range of motion). Medications should be reviewed and sedating drugs discontinued if safer alternatives exist. It has been difficult to consistently show associations between some drug classes and driving in pain ent. The gap between theoretical and real risk has recently been illustrated in a major European study, which showed reduced crash risk with antihistamines and another that showed only significant risk with the use of benzodiazepines (Orriols et al., 2009). Yet, a recent evidence-based review did find many associations of driving impairment with certain medications and these should be avoided or minimized when operating a motor vehicle especially in older adults with cognitive impairments: sedating antihistamines, antipsychotics, tricyclic antidepressants, bowel/bladder antispasmodics, benzodiazepines, muscle relaxants, and narcotics (Hetland and Carr, 2014).

Psychometric tests
Studies regarding the utility of global cognitive measures like Mini-Mental State Examination (MMSE) for estimating driving in pain ent have been mixed (Fitten et al., 1995; Leskar et al.,

<table>
<thead>
<tr>
<th>CLINICAL MEASURE OF DEMENTIA SEVERITY</th>
<th>NO DEMENTIA (CDR = 0)</th>
<th>QUESTIONABLE OR VERY MILD DEMENTIA (CDR = 0.5)</th>
<th>MILD DEMENTIA (CDR = 1.0)</th>
<th>MODERATE TO SEVERE DEMENTIA (CDR = 2.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the Dem entia Specialist:</td>
<td>N( S D)</td>
<td>N( S D)</td>
<td>N( S D)</td>
<td>N( S D)</td>
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<td>N( S D)</td>
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<tr>
<td>Fully oriented</td>
<td>12 (1.9)</td>
<td>4.8 (5.9)</td>
<td>15.4 (5.2)</td>
<td>18.5 (5.5)</td>
</tr>
<tr>
<td>Judge ment intact</td>
<td>28.9 (1.3)</td>
<td>23.1 (2.5)</td>
<td>20 (3.9)</td>
<td>16.1 (4.7)</td>
</tr>
<tr>
<td>Function intact</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Personal case intact</td>
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</tbody>
</table>

(Based on samples that average 75 years of age and 14 years education)

From Johnson et al. (2009), Hille et al. (1992), Kenneth et al. (1998), Kemper et al. (1993), Morris et al. (1989), Nourhashemi et al. (2008).
Although the M M SE m ay correlate with degree of driving in paiment on road tests and history of crashes, it does not appear to predict future involvement in crashes and valid cut-off scores have not been defined (M olar et al., 2006). G iven its lim itation in predicting perform ance, we do not recom mend the M M SE for determi ning driving privileges. H owever, the scores can provide a rough estim ate of dem entia severity and possibly at-risk driving (e.g. need for further assessment) given known lim itations for race, education, sensory deprivation, etc.

In 2004, a m eta-analysis of neuropsychological tests of driving perform ance in patients with dem entia concluded that tests of visuospatial skills are the most relevant predictor of driving in paiment (Reger et al., 2004). M ore recently, visuospatial and executive function tests such as Trail Making Tests and maze completion (H elihan et al., 2005; O tt et al., 2008a) have been associated with driving in paiment in older adults with dem entia. O ne study that evaluated a dem entia education program modeled after the American M edical Association older driver curriculum suggested that physicians m ay be willing to adopt such tests (M euser et al., 2006). Psychom etric tests m ay serve to identify drivers at-risk (e.g. those that m ay warrant further evaluation by a perfom ance-based road test), but should not be the sole determinants in deciding to continue or revoke driving privileges (Freund, 2006; M olar et al., 2006). This was recently confirmed in an article showing the lack of predictive value for prospective crashes in older adults that completed the M M SE (Joseph et al., 2014).

H owever, som e recognize that standard clinical psychometric tests have little congruence with m odem models of driving behavior (Fuller, 2005) and a num ber of innovative approaches have been developed which seek to draw on these insights, including the A delaide Driving Self-Efficacy Scale (George et al., 2007) and a scale of strategic and tactical comprehension outlined by de Raedt in 2000 (D e Raedt and P onj业t-K ristofferson, 2000). H owever, neither of these approaches has yet been tested for utility with drivers with dem entia.

Referral

In the absence of a gold standard or consensus for determin ing driving com petency, clinicians may request assistance from a driving clinic or refer to other subspecialists in the community such as a geriatrician, psychiatrist, neurologist, or neuropsychologist. A Driver Rehabilitation Specialist (D R S) evaluates, develops, and implements driving services for individuals with disabilities. D R Ss in the US are often occupational therapists with additional training in driver evaluation, vehicle modification, and rehabilitation. O ccupational therapy practice guidelines for these evaluations have been published, but a recent review of practices across the US and Canada indicates assessments vary significantly across programs and few have adopted standardized tools (Komer-Brensky et al., 2006). A European project found similar results (M idleton et al., 2005). In addition, there are relatively few D R S’s trained and available in smaller communities.

A driving evaluation in the US costs approximately $350–$800 and is generally an out-of-pocket expense, but the situation varies in other countries. Clinicians who are interested in this service can contact the occupational therapy department in local hospitals or rehabilitation centers or the A D E D directory (see, online Web resources). M any local chapters of the A lzheimer’s advocacy organizations (such as the A lzheimer’s Association in the US) m ay provide referral sources for area driving evaluation programs.

A perform ance-based road test for drivers with dem entia could be considered to assist with risk stratification when; (a) there is observation of new in paiment in traffic skills (e.g. near m isses, failure to scan, etc.), (b) prom inent impairments in key cognitive domains (e.g. attention, executive function, visuospatial skills), and/or (c) the presence of a m id dem entia severity rating ( C DR = 1). Private or university-based driving clinics m ay not available to everyone, but m any driver licensing authorities can provide or facilitate on-road tests: in the US, every state D epartment of M otor Vehicles (D M V) conducts such tests. In Europe, there is a much broader range of options through state, not-for-profit, and private organizations (Sanderson et al., 2006).

A review of this topic concluded there was no evidence to dem onstrate the benefit of driving evaluations with respect to the preservation of m obility or a reduction in crashes (M atin et al., 2009). Y et, a recent longitudinal study noted crash rates for drivers with dem entia declined to the levels of healthy controls during a period of 3 years when evaluated with road tests every 6 m onths (O tt et al., 2008b). This finding was probably due to the rem oval of AD drivers who had failed road tests and were no longer driving and/or to changes in behavior of AD drivers who continued to drive.

M obility counseling

Patients m ay stop driving based on physician advice (Persson, 1993). T here is little data to suggest that
clinicians should recommend reducing exposure in patients with dementia (e.g., limiting trips) or mandating a co-pilot to significantly reduce driving risk. In fact, data would suggest the older drivers at highest risk for a crash are the infrequent drivers that are on the road less than 3,000 km (2,000 miles) a year (Langford et al., 2006). Two recent education interventions for health professionals were positively associated with proving communication when discussing driving with patients with dementia and for using tools that might be of help in the assessment process (Byssewski et al., 2003; Euser et al., 2006).

Driving cessation has been associated with a decrease in social integration (Mazuk and Rebok, 2008), decreased out-of-home activities (Mazotti et al., 2000), an increase in depressive and anxiety symptoms in the elderly (Fonda et al., 2001), and an increased risk of nursing home placement (Freeman et al., 2006). Thus, a recommendation to stop driving should not be taken lightly by the clinician. Often, the situation is not urgent and there is time to work through the process of mobility loss. The brochures “We Need to Talk” and “At the Crossroads” from The Hartford Foundation (see Web resources) could enhance communication with the patient, their family, and their clinicians and assist the patient and the family member to reach important driving decisions and maintain linkage with key destinations. Educational interventions with these materials and group meetings may be effective ways to prepare caregivers for dealing with this difficult issue (Stein et al., 2008). Referral to social workers or gerontological care managers may provide in-patient local and regional transportation options. Caregiver support groups for families also have proven efficacy with driving cessation (Dobbs et al., 2009). Finally, the Independent Transportation Network (ITN) America is a model program that assists seniors with transportation to needed destinations and now has many sites across the US (see Web resources).

The physician’s legal and ethical obligations

Many physicians are uncertain of their legal responsibility to report unsafe drivers to the state or local licensing authorities (Miller and Morley, 1993; Kelly et al., 1999). In Europe, all jurisdictions rely on reporting by the driver or family, with third-party reporting the exception from a physician. The AMA’s policy states, “In situations where clear evidence of substantial driving in a patient implies a strong threat to patient and public safety, and where the physician’s advice to discontinue driving privileges is ignored, it is desirable and ethical to notify the DMV” (American Medical Association, 1999). Obviously, it is preferred that referrals to the license authority be done with the patient’s knowledge, and that the report be documented in the medical record. However, in any primary care physicians, fearing the deterioration of a long-standing relationship with their patient, may be reluctant to be this forthcoming. If a physician decides to report an unsafe driver, most jurisdictions in the US will accept a formal referral.

Physicians may be in a “double bind” concerned that they will be liable for breach of confidentiality, but also fearing legal action if they fail to report an unsafe cognitively impaired driver who is involved in an injurious crash. Most legal experts found on the side of reporting where the physician believes that the patient and community are at high risk for a crash. Since laws and regulations on driving often change, clinicians should review their laws, statutes, and regulations in their own jurisdiction to determine current requirements. Development of specific policies regarding reporting should be vetted by legal advice. In jurisdictions with voluntary reporting laws, we recommend formal referral to the driver licensing authority for refractory cases or for those patients deemed to be at a very high risk for a crash and/or injury.

Studies are needed to compare the benefits and costs of mandatory reporting to driver licensing authorities with voluntary reporting, although studies in other illnesses are not supportive of mandatory reporting (McLachlan et al., 2007). Decision analysis studies have not shown the benefits of systematically screening and evaluating drivers with dementia (Retchin and Hilker, 1994; Leproust et al., 2008). Some studies have noted positive impact on driving of cognitive stimulation (Edwards et al., 2005) and exercise interventions on older adults (Mamighian et al., 2009), although these studies were not performed in patients with dementia. Intervention studies are needed in the earliest stages of the disease to determine whether driving could be maintained safely. As the baby boom generation comes of age, there will be a pressing need to develop comprehensive interventions to maintain driving life expectancy and to develop alternative transportation systems for our cognitively impaired older drivers. The new era of smart cars and smart roads may be of assistance to those older adults with cognitive and/or physical frailty as they try to navigate down the road in the future.

Conflict of interest

Dr. Carr has support from the NIA, Missouri Department of Transportation Division of Traffic.
and Highway Safety. He has been a paid consultant for the American Medical Association Older Driver Project, ADEPT, TIRF, and M edscape in the past two years. Prof O'Neill is D irector of the N ational Program m e Office for T raffic M edicine, Ireland.

Description of authors' roles

Each author wrote paragraphs, reviewed the literature, and modified each other's contributions.

Web Resources on D ementia and D riving (All accessed 04/12/15)

1. General guidelines for the clinician that include dementia and additional medical conditions
   a. CMA Fit for D riving
      https://www.cm a.ca/en/Pages/drivers-guide .aspx
   b. A s sociation ofD river R ehabilitation Specialists
      https://www.aotadriversearch.com
   c. Irish M edical G uidelines
      http://www. rmsa.idoc mum ented%20 D rivers/M edical-I ssues%20inte agus%20t O%20m edical%20Fit%20for%20d riving%20Guidelines.pdf
   d. A M A O lder Driver C urriculum on AGS w ebsite

2. For difficult cases, consider referring to a driving rehabilitation specialist
   a. AOTA
      http://www.aota.org/driver_search/index .aspx
   b. A s sociation ofD river R ehabilitation Specialists: ADED

3. For refusals cases, consider referral to D istrict Attorney or C ounty Attorney
   a. Summary of United State Guidelines
      http://www.dhs.ohio/tips/caselaws/olderdriving/topcqanforolder-drivers

4. Consider W eb R esources and O ffice H andouts
   a. W eN eed to T alk and A t the C rossroads
      http://www.thehartford.com/in/true-me-market-excellence/publications-on-aging
   b. A lzheimer's A ssociation: D ementia and D riving R esource C enter
      http://www.alz.org/care/alzheimer circumstance-and-driving

5. Transportation Alternatives/Social Workers, Case M anagers or Local A rea on A ging

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