Driving Safety in Alzheimer’s Disease

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Outline

- Case
- Background information
- Natural course of driving ability in Alzheimer’s disease (AD)
- Predictors of driving impairment
- Screening for driving impairment
- Discussing driving cessation and DMV reporting
The case of T.G.

CC: “I still don’t like the food...”

HPI: 86-year-old widowed man with a history of AD, residing at Cortland Place assisted living facility, who presents to establish care as a transfer from a previous fellow. He is accompanied by his daughters. He states that his mood is stable and he is eating and sleeping well. Though he denies significant memory problems, his daughters report that his short-term memory has gradually worsened over the past 18 months. They notice that he is repetitive and has difficulty remembering the plans they have made for a particular day. They have taken over his finances; the facility provides his meals and prompts him to take his medications.
The case of T.G.

His daughters are most concerned about his driving. He has unlimited access to his car and usually does not tell his family when he plans on taking a trip. Though much of his driving is local (church, grocery store), he also visits friends in nearby towns which requires driving on the highway. The patient denies having gotten lost or any recent MVAs or near-misses. His daughters rarely observe him driving and so do not have first-hand knowledge of his driving abilities. He reports, “my driving is fine. I’ve been driving longer than you’ve been alive.”
Past Psychiatric History: Onset of progressive memory impairment after death of wife 18 months ago, which is when he moved into assisted living. Diagnosed with AD and started on donepezil about one year ago.

Past Medical History: NIDDM, HTN, hyperlipidemia, vitamin B12 deficiency

Medications: donepezil, amlodipine, atorvastatin, lisinopril, metoprolol, vitamin B complex

Family History: denied

Social History: HS graduate, worked as an airport supervisor and retired in 2011. Wife passed away in 2013. Two supportive daughters.
The case of T.G.

Mental Status Exam:
Patient is alert, casually dressed and well-groomed. Good eye contact. No abnormal movements noted. Speech is normal rate, rhythm and volume with a paucity of content. Mood is “good,” affect is constricted and irritable when discussing driving (e.g. “Dr. Ahmed wouldn’t ask me about this.”) Thought process concrete and confused, thought content is free of delusions. No hallucinations. No suicidal or homicidal ideation. Insight and judgment are impaired.
The case of T.G.

MOCA

- Visuospatial/executive: 1/5
- Naming: 3/3
- Attention: 6/6
- Language: 0/3
- Abstraction: 1/2
- Recall: 0/5
- Orientation: 2/6

+1 for education ≤ 12 years

Total = 14/30 (down from 18/30 one year prior)
The case of T.G.

Had a lengthy discussion with patient and daughters addressing poor cognitive testing performance and implications for driving safety. Advised patient that he should stop driving. He was reluctant but agreed to stop driving until a formal driving assessment was completed. Daughters were completely on board.
The case of T.G.

Four weeks later....

Patient and daughters return, reporting that patient had two back-to-back accidents in the Providence Place Mall parking garage during the Christmas season. He hit one car causing $1000 worth of damage to it, then as he was leaving the garage went into wrong exit lane then backed his car into a concrete pillar causing $10,000 worth of damage to it. Fortunately, there were no injuries.

At time of appointment, his car was still in the shop and daughters implied that it would be there indefinitely. He never received a driving assessment.
Driving and the elderly

- According to the Department of Transportation, in 2009 there were 33 million licensed drivers aged 65 and older in the U.S.
- Census projections estimate that by the year 2020 there will be 53 million persons over age 65 and approximately 40 million of those will be licensed drivers.
- There has also been a progressive increase in miles driven for each successive cohort of elderly over the past decades.
Driving and the elderly

- Older drivers make up 9% of the population but 13% of all traffic fatalities
  - When controlling for distance traveled, older drivers are nine times more likely than younger drivers to be killed in a car crash
- Motor vehicle injuries are the leading cause of injury-related deaths among 65- to 74-year-olds and are the second leading cause among 75- to 84-year-olds (after falls)
- For drivers over the age of 85, the per-mile fatality rate is highest of any group, including male teenagers.
- Elderly drivers are more likely to be involved in accidents during the day, in good weather, at intersections and while turning left (six times greater than non-elderly)
Cognitively impaired drivers

- Canadian data show that 28% of people aged 65 and older diagnosed with AD or another dementia have a driver’s license and 73% of those individuals had driven in the previous month.

- In one community-based study in N. Carolina, 3238 drivers 65 and older applying for a driver’s license renewal were examined using the Short Blessed Mental Status Examination.
  - Moderate to severe impairment (score ≥ 9 errors out of 28 possible, considered c/w dementia) in 6.2% of those 65 and 69 years old, 7.7% of those 70 and 74 years old, 11.9% of those 75 and 79 years old and 18.7% of those 80 years and older.

Short Blessed Test

1. What year is it now? ________________
   Correct (0)   Incorrect (1)

2. What month is it now? ________________
   Correct (0)   Incorrect (1)

Please repeat this name and address after me:
   John Brown, 42 Market Street, Chicago
   John Brown, 42 Market Street, Chicago
   John Brown, 42 Market Street, Chicago

   (underline words repeated correctly in each trial)
   Trials to learning _______ (can’t do in 3 trials = C)

   Good, now remember that name and address for a few minutes.

3. Without looking at your watch or clock, tell me about what time it is.
   (If response is vague, prompt for specific response)
   (within 1 hour) _______
   Actual time: ________________

4. Count aloud backwards from 20 to 1
   (Mark correctly sequenced numerals)
   If subject starts counting forward or forgets the task, repeat instructions and score one error

   20 19 18 17 16 15 14 13 12 11
   10 9 8 7 6 5 4 3 2 1

5. Say the months of the year in reverse order.
   If the tester needs to prompt with the last name of the month of the year, one error should be scored
   (Mark correctly sequenced months)

   D N O S A J L J N M Y A P M R F J

6. Repeat the name and address I asked you to remember.
   (The thoroughfare term (Street) is not required)
   (John Brown, 42 Market Street, Chicago)

   _____ _____ ___ __________ _______
Cognitively impaired drivers

- Drivers with dementia have two to five times greater risk of involvement in a crash compared to age-matched controls according to numerous studies.¹
- In driving simulation studies, drivers with AD are more likely to drive off the road, drive under the speed limit, brake unexpectedly, have less awareness of other drivers, have worse lane control, make slower left turns and make more errors at intersections.¹
- Cognitively impaired individuals may be less likely to self-limit their driving than drivers impaired for other reasons (e.g. visual loss) due to poor insight.

Driving with dementia
Driving cessation in AD

- Most agree that those with moderate or severe dementia should not drive.
- But many individuals are diagnosed early in their disease course and may be able to drive safely for some time.
- No consensus amongst physicians on how to best assess driving or when to advise driving cessation.
- Driving cessation is far from benign and has been associated with increased social isolation, decreased out-of-home activities, increased depressive and anxiety symptoms and increased risk of SNF placement.
  - “I would rather tell a patient he has cancer than tell him he should no longer drive. At least with a cancer diagnosis there is hope.”
Longitudinal study of driving in AD

- Longitudinal study of 128 older drivers (66 probable AD, 23 possible AD, 45 controls) recruited from the memory disorder clinics at RIH and Memorial Hospital by Ott et al.
- MMSE, Clinical Dementia Rating (CDR) and a neuropsychology battery along with a driving test were completed every 6 months for 2 to 3 years by subjects with AD and at baseline and 18 months for normal controls.
- Crashes and traffic violations collected from subject, informant and motor vehicle registries.
- Exclusion criteria: (1) reversible causes of dementia, (2) physical, ophthalmological or neurological disorders other than dementia that might impair driving abilities and (3) certain psychiatric disorders including mental retardation, schizophrenia, bipolar disorder or substance abuse within the past year.
Longitudinal study of driving in AD

- Driving road test administered by professional instructor during daytime w/good road conditions
- 10- to 15-minute pre-test in a parking lot, 45-minute road test based on Washington University road test and adapted for RI streets to assess variety of important driving behaviors
- Driving test performance scored from 0 (worst) to 108 (best)
- Those who failed test, had an at-fault accident or advanced beyond mild stage of dementia were advised to stop driving ➔ all complied
Clinical Dementia Rating

- 90-minute structured interview of subject and collateral informant that assesses a patient's cognitive and functional performance in six areas: memory, orientation, judgment & problem solving, community affairs, home & hobbies, and personal care
- Global score calculated using algorithm
## Clinical Dementia Rating

<table>
<thead>
<tr>
<th>CLINICAL DEMENTIA RATING (CDR)</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impairment</td>
<td>None</td>
<td>Questionable</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Memory</td>
<td>No memory loss or slight inconsistent forgetfulness</td>
<td>Consistent slight forgetfulness; partial recollection of events; “benign” forgetfulness</td>
<td>Severe memory loss; only highly learned material retained; new material rapidly lost</td>
<td>Severe memory loss; only highly learned material retained; new material rapidly lost</td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td>Fully oriented</td>
<td>Fully oriented except for slight difficulty with time relationships</td>
<td>Moderate difficulty with time relationships; oriented to place of examination; may have geographic disorientation elsewhere</td>
<td>Severe difficulty with time relationships; usually disoriented to time, often to place</td>
<td></td>
</tr>
<tr>
<td>Judgement &amp; Problem Solving</td>
<td>Solves everyday problems and handles business and financial affairs well; judgement good in relation to past performances</td>
<td>Slight impairment in solving problems, similarities and differences</td>
<td>Severely impaired in handling problems, similarities and differences; social judgement usually impaired</td>
<td>Unable to make judgements or solve problems</td>
<td></td>
</tr>
<tr>
<td>Community Affairs</td>
<td>Independent function at usual level in job, shopping, volunteer and social groups</td>
<td>Slight impairment in these activities</td>
<td>Unable to function independently at these activities although may still be engaged in some; appears normal to casual inspection</td>
<td>No pretence of independent function outside home</td>
<td></td>
</tr>
<tr>
<td>Home &amp; Hobbies</td>
<td>Life at home, hobbies and intellectual interests well maintained</td>
<td>Life at home, hobbies and intellectual interest slightly impaired</td>
<td>Mild but definite impairment of function at home more difficult tasks abandoned; more complicated hobbies and interests abandoned</td>
<td>Only simple tasks preserved; very restricted interests, poorly maintained</td>
<td></td>
</tr>
<tr>
<td>Personal Care</td>
<td>Full capable of self-care</td>
<td>Needs prompting</td>
<td>Requires assistance in dressing, hygiene, keeping of personal effects</td>
<td>Requires much help with personal care; frequent incontinence</td>
<td></td>
</tr>
</tbody>
</table>

Clinical Dementia Rating

Calculation of Global Clinical Dementia Rating Score (Form B4: CDRGLOB)

This page allows the user to input CDR box scores and submit them to a SAS computer program which returns the global CDR based on the Washington University CDR-assignment algorithm.

<table>
<thead>
<tr>
<th>Select the CDR Box Scores</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judgement and Problem Solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Affairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home and Hobbies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Submit Press to submit.

Reset Press to reset all box scores.
### Table 3
Global driving rating on road test at baseline and 18 months by group

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th>18 Months</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controls (n = 44)</td>
<td>Patients (n = 84)</td>
<td>Controls (n = 21)</td>
<td>Patients (n = 26)</td>
</tr>
<tr>
<td>Safe</td>
<td>35 (80)</td>
<td>34 (41)</td>
<td>12 (57)</td>
<td>5 (19)</td>
</tr>
<tr>
<td>Marginal</td>
<td>9 (20)</td>
<td>37 (44)</td>
<td>8 (38)</td>
<td>17 (66)</td>
</tr>
<tr>
<td>Unsafe</td>
<td>0</td>
<td>13 (15)</td>
<td>1 (5)</td>
<td>4 (15)</td>
</tr>
</tbody>
</table>

Values are n (%).
Longitudinal study of driving in AD

Table 5

<table>
<thead>
<tr>
<th></th>
<th>Global driving rating on road test at baseline and 18 months by CDR at time of visit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>Safe</td>
<td></td>
</tr>
<tr>
<td>Safe</td>
<td></td>
</tr>
<tr>
<td>Safe</td>
<td>0 (35) (80)</td>
</tr>
<tr>
<td>Safe</td>
<td>0 (9) (20)</td>
</tr>
<tr>
<td>Unsafe</td>
<td>0</td>
</tr>
</tbody>
</table>

Values are n (%).
CDR = Clinical Dementia Rating.

Longitudinal study of driving in AD

• CDR 1 group had a failure hazard that was almost four times higher than that of the CDR 0.5 group, with a median time to failure that was almost twice as fast as that of the CDR 0.5 group (324 vs. 605 days)

• Cannot assume that all patients with the same level of dementia have the same driving ability

• Authors recommend driving assessments every six months as reasonable follow-up, but can be difficult to access

• Generalizability?
Clinician assessment of driving ability

- Study by Ott et al of 50 patients with possible or probable AD from the aforementioned longitudinal study
- Informants spent time with patients more than once/week and accompanied patient while driving at least once/month for preceding 12 months
- Primary study physician + five other clinicians assessed each subject’s ability to drive on a trichotomous scale: (1) drives alone with good sense of direction and good driving skills (2) drives but with some difficulty or (3) unable to drive safely
  - Assessment based on information from diagnostic interview, CDR and MMSE, physical examination and patient/informant reports about past MVAs and traffic violations
Clinician assessment of driving ability

- Clinicians completed a visual analog rating scale for each of 22 variables that were available to them from the records, indicating the weight that they gave each variable in their assessment of competence (none to very much)
- Clinician ratings were dichotomized into safe versus unsafe (marginal + unsafe)
- Each subject completed a driving test and was rated on same scale by driving instructor
Clinician assessment of driving ability

Table 1. Clinician Predictions of Drivers Rated Categorically Safe by the Driving Instructor

<table>
<thead>
<tr>
<th>Clinician</th>
<th>JB</th>
<th>BO</th>
<th>AD</th>
<th>CW</th>
<th>AC</th>
<th>DA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>59.1</td>
<td>95.2</td>
<td>49.5</td>
<td>59.1</td>
<td>40.9</td>
<td>45.5</td>
</tr>
<tr>
<td>Specificity</td>
<td>92.9</td>
<td>59.3</td>
<td>96.4</td>
<td>82.1</td>
<td>82.1</td>
<td>75</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>86.7</td>
<td>64.5</td>
<td>90.9</td>
<td>72.2</td>
<td>64.3</td>
<td>58.8</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>74.3</td>
<td>94.1</td>
<td>69.2</td>
<td>71.9</td>
<td>63.9</td>
<td>63.6</td>
</tr>
<tr>
<td>Correct classification</td>
<td>78*</td>
<td>75*</td>
<td>74*</td>
<td>72*</td>
<td>64*</td>
<td>62</td>
</tr>
</tbody>
</table>

*P < .05, chi-square.
Clinician assessment of driving ability

Figure 1. Weights placed on variables used by clinicians to make their ratings (visual analog scale). Exam = examination.
Clinician assessment of driving ability

- Accuracy was greatest for physicians with specialized training in dementia, regardless of their years of clinical experience
  - The senior geriatric neurologist, the geriatric neurology fellow and the geriatric psychiatry fellow were the most accurate; the general practitioner, geriatric nurse practitioner and neurologist/dementia specialist were less accurate
- The largest discrepancy between the two groups was in the weight given to dementia duration, which the most-accurate raters more heavily weighed
  - “Three year guideline” found in multiple studies: crash rate in AD increases above control rates three years after onset
- GPs can be trained to weigh the most relevant variables more heavily
Evaluation of driving safety

- Most patients early in the course of dementia are still able to pass a driving performance test; therefore, a diagnosis of dementia should not be the sole justification for the revocation of a driver’s license
- On-road driving test is the gold standard but expensive and difficult to access ($300-400, not covered by Medicare, trained evaluators scarce)
- In terms of history, most experts recommend heavily weighing family concern and recent MVAs/traffic violations
- Patients will often deny that they are having any difficulty
Am I a Safe Driver?

Check the box if the statement applies to you.

☐ I get lost while driving.
☐ My friends and family members say they are worried about my driving.
☐ Other cars seem to appear out of nowhere.
☐ I have trouble seeing signs in time to respond to them.
☐ Other drivers drive too fast.
☐ Other drivers often honk at me.
☐ Driving stresses me out.
☐ After driving, I feel tired.
☐ I have had more “near misses” lately.
☐ Busy intersections bother me.
☐ Left-hand turns make me nervous.
☐ The glare from oncoming headlights bothers me.
☐ My medication makes me dizzy or drowsy.
☐ I have trouble turning the steering wheel.
☐ I have trouble pushing down on the gas pedal or brakes.
☐ I have trouble looking over my shoulder when I back up.
☐ I have been stopped by the police for my driving recently.
☐ People will no longer accept rides from me.
☐ I don’t like to drive at night.
☐ I have more trouble parking lately.

If you have checked any of the boxes, your safety may be at risk when you drive. Talk to your doctor about ways to improve your safety when you drive.
Use of MMSE in evaluation of driving safety

- Large prospective study by Joseph et al (2014) of baseline MMSE as predictor of involvement in an MVC
- Some guidelines (such as from the American Academy of Neurology) use MMSE ≤ 24 as an indicator of driving risk
- Included 17,538 “frequent drivers” (driving at least once per week) age 55 and above with cardiovascular disease or diabetes mellitus that were enrolled in two large cardiovascular medication studies from 733 centers in 40 countries
Use of MMSE in evaluation of driving safety

- MVC incidence determined by self-report at 2-year follow-up and penultimate visit (mean 4.5 years); MVC as reason for hospitalization or death also determined
- Total follow-up time of 79,631 person-years
- During follow-up, 1,068 (6.1%) of participants were involved in a MVC as the primary driver (0.01 crashes/person-year)
- Fifty-five (5.1%) of MVCs required hospitalization and nine MVC-related fatalities were identified, with three confirmed to have occurred while the participant was the primary driver
Use of MMSE in evaluation of driving safety


Model 1: Unadjusted.
Model 2: Multivariable model using age, sex, education level, region of habitation, employment status, categorical MMSE score, history of MVC in past 2 years, falls within past year, alcohol consumption, prior stroke, systolic blood pressure, diabetes mellitus, use of oral hypoglycemic agent or insulin, laser treatment for diabetic retinopathy, cataracts, sleep apnea, physical activity score, psychosocial stress score, and depression as covariates.

Table 2. Motor Vehicle Crash (MVC) Risk According to Mini-Mental State Examination (MMSE) Score

<table>
<thead>
<tr>
<th>MMSE Score (Reference 30)</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hazard Ratio (95% Confidence Interval)</td>
<td>P-Value</td>
</tr>
<tr>
<td>27–29</td>
<td>1.16 (1.01–1.32)</td>
<td>.03</td>
</tr>
<tr>
<td>24–26</td>
<td>1.03 (0.85–1.27)</td>
<td>.74</td>
</tr>
<tr>
<td>&lt;24</td>
<td>0.80 (0.55–1.14)</td>
<td>.21</td>
</tr>
</tbody>
</table>
Use of MMSE in evaluation of driving safety

- MVC in the previous 2 years, depression, sleep apnea, recent falls and lower SBP were associated with future MVCs
- MMSE primarily evaluates verbal cognitive function, with less emphasis on the visual attention, spatial orientation, and executive function skills that have a greater effect on driving performance
Other predictors of driving safety

- Study by Dawson et al compared 40 drivers with probable early AD (mean MMSE 26.5) and 115 cognitively normal elders on a battery of cognitive, visual and motor tests and a standardized 35-mile driving route using instrumented vehicle during daytime/good weather

- Exclusion criteria included non-AD neurologic disease, brain lesions due to cerebrovascular or neoplastic disease, alcoholism, stroke, depression or other psychiatric conditions, vestibular disease and motion sickness.
Other predictors of driving safety

Neuropsychological tests included:
- Rey-Osterreith Complex Figure Test-Copy: visuoconstruction
- Complex Figure Test-Recall: visual memory
- Block Design subtest from WAIS-R: visuoconstruction
- Benton Visual Retention Test: visual working memory
- Trail-Making Test B: executive function, working memory, attentional set shifting
- Rey Auditory Verbal Learning Test: verbal memory
- Judgment of Line Orientation: visuospatial perception
- Controlled Word Association Test: phonemic fluency

Composite COGSTAT score calculated
Driving safety errors categorized by expert based on video review
Table 2  Driver safety errors in Alzheimer disease (AD) and normal control groups

<table>
<thead>
<tr>
<th>Safety errors</th>
<th>AD (n = 40)</th>
<th>Controls (n = 115)</th>
<th>p Values for difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Age- and gender-adjusted</td>
<td></td>
</tr>
<tr>
<td>Starting and pulling away from curve</td>
<td>1.08 (0.97)</td>
<td>1.09 (0.81)</td>
<td>0.7097</td>
</tr>
<tr>
<td>Traffic signals</td>
<td>2.35 (1.56)</td>
<td>2.18 (1.56)</td>
<td>0.5101</td>
</tr>
<tr>
<td>Stop signs</td>
<td>3.80 (1.98)</td>
<td>3.61 (1.89)</td>
<td>0.7610</td>
</tr>
<tr>
<td>Other signs</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>—</td>
</tr>
<tr>
<td>Turns</td>
<td>6.50 (3.09)</td>
<td>5.44 (2.79)</td>
<td>0.0838</td>
</tr>
<tr>
<td>Lane observance</td>
<td>17.03 (11.00)</td>
<td>10.84 (7.77)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Lane change</td>
<td>5.75 (2.86)</td>
<td>5.00 (2.75)</td>
<td>0.1253</td>
</tr>
<tr>
<td>Overtaking</td>
<td>0.10 (0.38)</td>
<td>0.15 (0.46)</td>
<td>0.5075</td>
</tr>
<tr>
<td>Control of speed</td>
<td>4.03 (2.71)</td>
<td>3.56 (2.79)</td>
<td>0.2634</td>
</tr>
<tr>
<td>Backing up</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>—</td>
</tr>
<tr>
<td>Parallel parking</td>
<td>0.38 (0.49)</td>
<td>0.37 (0.52)</td>
<td>0.8172</td>
</tr>
<tr>
<td>Head-in parking</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>—</td>
</tr>
<tr>
<td>Curves</td>
<td>0.00 (0.00)</td>
<td>0.01 (0.09)</td>
<td>0.5653</td>
</tr>
<tr>
<td>Railroad crossing</td>
<td>0.03 (0.16)</td>
<td>0.19 (0.58)</td>
<td>0.1115</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0.98 (1.03)</td>
<td>0.73 (1.05)</td>
<td>0.0859</td>
</tr>
<tr>
<td>Total safety errors</td>
<td>42.00 (12.84)</td>
<td>33.18 (12.22)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total more serious errors</td>
<td>4.35 (2.97)</td>
<td>1.90 (1.59)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total less serious errors</td>
<td>37.65 (11.66)</td>
<td>31.26 (11.49)</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

Groups were compared using Wilcoxon rank sum for crude p values and multiple linear regression for adjusted p values.
<table>
<thead>
<tr>
<th>Table 3</th>
<th>Changes in total safety errors for a 1 SD increase in cognitive, visual, and motor predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictors</td>
<td>Coefficient estimate (SE)</td>
</tr>
<tr>
<td><strong>Cognitive tests</strong></td>
<td></td>
</tr>
<tr>
<td>CFT-Copy</td>
<td>$-3.54 (1.54)^*$</td>
</tr>
<tr>
<td>CFT-Recall</td>
<td>$-4.44 (2.38)^*$</td>
</tr>
<tr>
<td>JLO</td>
<td>$-0.58 (1.97)$</td>
</tr>
<tr>
<td>Blocks</td>
<td>$-2.29 (1.91)$</td>
</tr>
<tr>
<td>BVRT (Errors)</td>
<td>$4.12 (1.55)^*$</td>
</tr>
<tr>
<td>TMT-A</td>
<td>$2.97 (1.46)^*$</td>
</tr>
<tr>
<td>TMT-B</td>
<td>$2.40 (1.35)^*$</td>
</tr>
<tr>
<td>AVLT</td>
<td>$2.43 (2.48)$</td>
</tr>
<tr>
<td>COWA</td>
<td>$-2.37 (2.31)$</td>
</tr>
<tr>
<td>COGSTAT</td>
<td>$-4.14 (1.66)^*$</td>
</tr>
</tbody>
</table>

| **Visual tests** | |
| Contrast sensitivity | $0.32 (1.86)$ |
| UFOV-Total | $3.44 (1.72)^*$ |
| Near visual acuity | $-1.48 (1.38)$ |
| Far visual acuity | $0.22 (2.06)$ |
| Structure from motion | $-0.25 (1.49)$ |

| **Motor tests** | |
| Get-Up-and-Go | $2.79 (2.55)$ |
| Functional Reach | $-4.31 (1.99)^*$ |
| Grooved Pegboard | $0.80 (1.54)$ |

Coefficients and $p$ values for multiple linear regression, adjusting for age and gender. Values expressed as coefficient estimate (SE).

* $p < 0.05$.

* $p < 0.10$. 

Other predictors of driving safety

- Significant predictors of safety errors in those with AD included total COGSTAT score, BVRT score (working memory), TMT-A (visual search and visual motor speed), CFT-copy (visuoconstructional ability) and Functional Reach (measure of balance).
- Anterograde memory is not a good predictor.
Use of CDT in evaluation of driving safety

- Study by Freund et al looking at whether the Clock Drawing Test (CDT) predicted driving simulator performance in 119 adults 60 and older in an outpatient driving evaluation clinic
- CDT measures comprehension, memory, visuospatial abilities, abstract thinking, and executive function
- Subjects are verbally instructed to “draw a clock, put all the numbers in, and set the time at 10 minutes after 11”
- Driving simulator used a 30-minute urban course
- Subjects are judged as safe, conditional safe (restricted), or unsafe (failure) based on the number and type of driving errors committed
| Time (3 points) | \( \begin{align*} \text{One hand points 2 (or symbol representative of 2)} \\
\text{Exactly two hands} \\
\text{Absence of intrusive marks, e.g., writing or hands indicating incorrect time, hand points to number 10; tic marks, time written in text (11:10; ten after eleven)} \end{align*} | |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers (2 points)</td>
<td>Numbers are inside the clock circle</td>
<td>All numbers 1–12 are present, no duplicates or omissions</td>
</tr>
<tr>
<td>Spacing (2 points)</td>
<td>Numbers spaced equally or nearly equally from each other</td>
<td>Numbers spaced equally or nearly equally from the edge of the circle</td>
</tr>
</tbody>
</table>
Table 5

<table>
<thead>
<tr>
<th>CDT Score</th>
<th>Sensitivity</th>
<th>95% CI</th>
<th>Specificity</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9</td>
<td>0.3 to 10.1</td>
<td>100</td>
<td>91.7 to 100</td>
</tr>
<tr>
<td>1</td>
<td>7.5</td>
<td>2.1 to 18.2</td>
<td>100</td>
<td>91.7 to 100</td>
</tr>
<tr>
<td>2</td>
<td>20.8</td>
<td>10.9 to 34.1</td>
<td>97.7</td>
<td>87.7 to 99.6</td>
</tr>
<tr>
<td>3</td>
<td>41.5</td>
<td>28.1 to 55.9</td>
<td>97.7</td>
<td>87.7 to 99.6</td>
</tr>
<tr>
<td>4</td>
<td>64.2</td>
<td>49.8 to 76.9</td>
<td>97.7</td>
<td>87.7 to 99.6</td>
</tr>
<tr>
<td>5</td>
<td>84.9</td>
<td>72.4 to 93.2</td>
<td>76.7</td>
<td>61.4 to 88.2</td>
</tr>
<tr>
<td>6</td>
<td>96.2</td>
<td>87.0 to 99.4</td>
<td>58.1</td>
<td>42.1 to 73.0</td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>93.2 to 100</td>
<td>0.0</td>
<td>0.0 to 8.3</td>
</tr>
</tbody>
</table>

CDT, Clock Drawing Test; CI, confidence interval.
Use of CDT in evaluation of driving safety

- Using a cutoff of ≤4 provides moderate sensitivity (64.2%) and high specificity (97.7%) in predicting unsafe driving performance
- Limits false positives but allows for false negatives
  - Authors concerned about wrongful driving cessation
  - Someone can score well on CDT but still need further evaluation if there are other reasons for concern
  - Can consider a higher cutoff if resources available for further driver evaluation
American Academy of Neurology Quality Standards Subcommittee conducted a systematic review of 422 studies of driving and cognitive impairment in order to develop a revised practice parameter in 2010.
### Evaluation and Management of Driving Risk in Dementia

#### CDR 0.5-1.0
- Evaluate for risk factors

#### CDR 2.0
- Risk factors
  - Caregiver report of marginal or unsafe skills
  - History of citations
  - History of crashes
  - Driving < 60 miles/week
  - Situational avoidance
  - Aggression, impulsivity
  - MMSE ≤24

#### Level B evidence
- Alcohol, medications, sleep disorders, visual impairment, motor impairment

#### Level C evidence

#### Other

#### Risk factors:
- None
  - CDR 0.5
  - CDR 1.0
- Few
  - CDR 0.5
  - CDR 1.0
- Several
  - CDR 0.5
  - CDR 1.0
- Multiple
  - CDR 0.5

#### Risk Management
- Encourage family support for alternate transportation.
- Strongly consider voluntary surrender of driving privileges.
- Consider DMV referral or professional driving evaluation, based on state guidelines.

#### Intervention pursuant to state guidelines
Discussing driving cessation

- If a patient has Alzheimer’s dementia (or another degenerative disease), the conversation about the eventual driving cessation and transportation alternatives should begin early.
- Ideally retirement from driving will be a gradual process with patient and family planning ahead.
- Unfortunately, often no one brings up driving cessation until there is an adverse event.
- Copilots should never be recommended to unsafe drivers as a means to continue driving.
Discussing driving cessation

- Explain why it is important to stop driving to patient and family
  - Give assessment results in easily understood terms and describe the potential risks of driving
- Give a clear, firm recommendation to stop driving
- Discuss alternative transportation options and involve family to make a transportation plan
- Reinforce driving cessation and test for understanding
  - “Do Not Drive” prescription, economic arguments can be helpful
- Follow-up with patient to see if recommendations were followed
Box 2. Steps Family Members Can Take to Ensure That a Resistant Patient With Dementia No Longer Drives

Approaches Involving Physician
Ask physician to “prescribe” driving cessation orally and in writing.
Ask physician to use medical conditions other than dementia as the reason to stop driving (e.g., vision too impaired, reaction time too slow).
Use a contract (see “At the Crossroads” in Resources).

Vehicle-Related Approaches
Hide, file down, or replace the car keys with keys that will not start the vehicle.
Do not repair the car or send vehicle for “repairs” but arrange for its removal.
Remove the vehicle by loaning, selling to third party, or donating to charity.
Disable the vehicle.

Financial and Legal Tactics
Ask family lawyer to discuss financial and legal implications of crash or injury to patient, family, or third party.
Refer to the Department of Motor Vehicles.
The American Medical Association’s Code of Medical Ethics on impaired drivers and their physicians states: “in situations where clear evidence of substantial driving impairment 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].”

Do not breach confidentiality without talking to patient and family first.
<table>
<thead>
<tr>
<th><strong>Reporting Procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandatory medical reporting</strong></td>
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<td><strong>Physician/medical reporting</strong></td>
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<td><strong>Immunity</strong></td>
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<td><strong>Legal protection</strong></td>
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<tr>
<td><strong>DMV follow-up</strong></td>
</tr>
<tr>
<td><strong>Other reporting</strong></td>
</tr>
</tbody>
</table>
Driving by the elderly is becoming increasingly common and AD significantly impairs driving ability.

Drivers with AD become unsafe at differing points in the disease course.

Road test or simulator every 6 months is the best way to monitor drivers with AD but is not always practical.

Screening tests of visuospatial and executive abilities (e.g. CDT) are the most helpful screening assessments, but also weigh risk factors (family concern, recent MVA/citations, self-limitation of driving, disease duration).

Start discussion of driving cessation early and involve family in making a transportation plan.
References

18. Slomski, Anita. Older patients: safe behind the wheel? Physicians may be reluctant to raise the question. JAMA 2010; 304(17): 1884-1886.
Questions?