COGNITIVE DEFICITS AND DRIVING ABILITY IN PATIENTS WITH PARKINSON'S DISEASE

Introduction - Background

- Parkinson's disease (PD) is a slowly progressive, degenerative disease of the basal ganglia with motor dysfunction as a cardinal feature, manifesting as akinesia, rigidity, resting tremor, postural instability, and autonomic dysfunction.
- PD causes cognitive (memory, visuospatial and executive function, attention, perception, emotion) and neuropsychiatric symptoms (agitation, hallucinations, delusions).
- The multimodal clinical picture of PD appears to influence in a negative way various aspects of cognition, behavior, and motor control that are closely linked to the capacity of an individual to maintain adequate driving skills.

Methodology:

- 22 primary studies relevant to cognitive functioning and driving ability were examined and finally included in the current review.

Epidemiologic data and crash rates of PD

- Dubinsky et al. in the early 90s found that PD drivers with more severe motor impairment as assessed by the Hoehn & Yahr (HY) scale experience an increased risk for car crashes.
- Meitinerof et al. in 2005 in a epidemiological study showed that 15% of the PD drivers with an active driving license was involved in car accident during a period that covered the past five years.
- However, findings from a recent prospective cohort study did not reveal differences in crash risk between patients with PD and controls even after adjusting for age, education, gender, and miles driven per week at baseline (Uc et al. 2008).
- In a recent study (Stolwyk et al. 2015) it was found that only subjective feelings of a decline in driving performance and not objective measures of cognitive functioning and simulated driving performance played a role in the driving cessation of patients with PD.

Main objective of this study:

- The authors conducted a review of a large number of studies that have explored the link between cognitive and functioning drivers to patients with PD.

Outcomes of Driving Simulator Procedures

- Stolwyk et al. 2006: Traffic Test B (TMT-B), the Brixton test and the Symbol Digit Modalities Test (SDMT) which assess executive function and processing speed, have shown strong correlation with several driving simulator measures:
  - Traffic signal approach, speed, traffic signal deceleration point, mean curve speed, and curve distance on mean lateral position.
  - In the same study, PD drivers:
    - needed more time to initiate deceleration,
    - had greater difficulty to stop at the proper position when approaching traffic signals,
    - had lower speeds during driving around curves and showed greater variation in vehicle lateral position when driving around curves.

- Low contrast environmental conditions have a negative impact on driving performance in PD drivers. Neuropsychological tests that evaluate visuospatial skills and motion perception might be used as predictors of driving performance under low contrast conditions, as well as some other criteria (Uc et al. 2009).
- PD drivers have increased difficulty in recalling road signs. This difficulty can be predicted by the difference between TMT-A and TMT-B or the combination of TMT-A and TMT-B and PD patients have executive function deficit (Ranchet et al. 2011).

Comparison of cognitive and motor measures

- The reduced driving performance of patients with PD was linked to the functioning of visual attention, visuospatial skills and visual memory (Uc et al. 2007, Uc et al. 2009).
- Executive function, information processing speed demonstrated better predictive value in predicting driving errors, while the staging of PD was not associated with these measures (Stolwyk et al. 2008).
- According to simulator data, motor measures and not only cognitive variables could have a central role in predicting fitness to drive under low visibility conditions, that require sufficient response speed in order to avoid a crash (Uc et al. 2009).

Conclusions and future directions

- Driving capacity in PD patients is mainly compromised due to cognitive deficits that engage attention, executive, and visuospatial resources, three crucial domains which affects:
  - journey planning
  - positioning and maneuvering the vehicle
  - judging distance and speed
  - predicting the development of driving situations
  - estimating risk and adapting driving behavior.
- The current evidence on driving performance of PD patients is based both on on-road and simulator studies, two different methodological approaches with different advantages and disadvantages.
- Prospective studies by combining information from on-road and simulator evaluations could reach to more solid conclusions on the effect size of various predictors on driving performance measures.
- An objective of future research should be the development of a wider array of Cut-Off scores. This kind of studies can facilitate decisions about the restriction or total loss of driving privileges.
- The combination of cognitive measures with brain imaging data could refine the methods currently used for assessing the driving ability of patients with PD.
- Criteria for selection of PD patients with PD should include:
  - the presence of a valid driver's license
  - regular and not occasional car driving
  - CDR score 1 and 1 + Hoehn & Yahr score > 3.
- On the other hand, exclusion criteria should be alcohol or illicit substance use and the presence of significant neuropsychiatric symptoms related to PD.

Acknowledgement

This paper has been performed within the framework of "IKY Fellowships of Excellence for Postgraduate Studies in Greece SIEMENS Program"