Parkinson's disease and driving ability

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Abstract

There is no guidance available for clinicians who have to decide on the fitness to drive of patients who have Parkinson's disease (PD). A computerised driving simulator was used to examine the effect of PD on driving ability. Ten drivers with idiopathic PD were tested as well as 10 age and sex-matched healthy drivers and four PD drivers who were no longer driving. Both the simulated driving reaction time and the accuracy of steering were significantly impaired in the PD group compared with the controls. Both of these measures correlated significantly with the severity of PD as measured on Webster's rating scale. Caution may be needed if the findings of simulated tests are to be extrapolated to real driving. However, our findings show that the severity of disability in PD as measured by Webster's rating scale may assist in assessing the fitness of a PD patient to drive.

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"Medical Aspects of Fitness to Drive"¹ stipulates the criteria by which a person may be deemed unfit to drive. However, the section on Parkinson's disease (PD) only contains the advice that sufferers should have a medical examination by a clinician (usually the patients' general practitioner) every three years. Nor

does it specify criteria on which the general practitioner may make a decision as to the safety of an individual patient to drive. Peterson, Nolan and Millingen² found that 32% of patients with PD who had been drivers had lost their driving licences because of the disease. It is desirable for uniform criteria to be adopted by all clinicians involved in making this assessment. If the relationship between driving ability and disability due to PD were more fully understood, it might be possible to establish objective criteria based on this disability for making a decision on the ability to drive of a particular patient. We examined this issue by using a driving simulator to investigate the relationship between driving ability and a standard clinical rating of disability.

Method

The driving simulator is a device run by a microcomputer, which involves two tasks being performed simultaneously. These are steering (using a steering-wheel) and responding to a change in colour of traffic lights on the display by pressing the accelerator and brake foot pedals as appropriate. The rationale for the use of this simulator has been described in detail by Hindmarch.³ Ten drivers with idiopathic PD who were volunteers from a longitudinal study of cognition and affect in PD⁴ and 10 healthy volunteer drivers, who were matched on the basis of age and sex, were

Table Showing the scores obtained by PD drivers, ex-drivers and control subjects on accuracy of steering, driving reaction time, simple reaction time and the total number of red lights missed. The Hoehn and Yahr ratings and Webster's ratings are shown for PD subjects. The mean scores and 95% confidence limits of the means are shown. Values for simple and driving reaction times are expressed in seconds. The lower accuracy scores represent a better performance

Patients							
Sex	Age	Hoehn and Yahr	Webster's scale	Accuracy	Driving reaction time	Simple reaction time	Red lights missed
M	38	3	11	40.2	0.62	0.55	0
M	47	2	10	38.3	0.70	0.49	6
F	50	2	6	36.2	0.65	0.40	1
F	51	1	3	17.2	0.78	0.37	1
M	54	3	12	62.0	0.80	0.39	4
M	58	1	4	20.8	0.68	0.41	0
M	60	2	12	50.5	0.78	0.63	0
F	61	1	2	21.3	0.59	0.38	0
M	63	2	9	29.2	0.71	0.41	1
M	64	3	9	32.6	0.88	0.65	1
Mean	54.6			34.8	0.72	0.47	1.4
95% Confidence limits	49.4-59.8			26.0-43.6	0.66-0.77	0.39-0.55	0.2-2.6
Ex-drivers							
F	56	1	12	30.8	0.82	0.55	0
M	69	1	6	21.2	0.71	0.42	1
M	76	3	11	47.0	0.93	0.54	6
M	77	2	10	44.8	0.83	0.53	1
Mean	69.5			36.0	0.82	0.51	
95% Confidence limits	57.4-81.6			24.0-47.9	0.74-0.90	0.45-0.57	

tested. A further four patients with PD who had been drivers, but who had given up, were also tested. They had taken no sedative medication or alcohol for the 24 hours preceding the test, and the PD drivers felt they were at their optimal level of performance (to rule out any “on-off” effect). The subjects practised until a constant level of performance was attained. An average of the next six trials was then taken. This generated scores for the simple and driving reaction times (in seconds), accuracy of steering (with lower scores being better), and number of red traffic lights missed. The PD patients were rated on Webster’s rating scale for the severity of motor impairment⁵ (which contains 10 items including ratings of bradykinesia, rigidity, posture and gait).

Results

There were seven males and three females in the control group and the group of PD patients who were currently drivers. The PD drivers mean score on Webster’s rating scale was 7.6 with a range from 2 to 12. The performance indicators of both groups are shown in the table.

Ranked non-parametric statistics were used in the analysis. The 5% level of probability (one tailed) was considered appropriate and all results quoted are significant at this level. Mann-Whitney U tests were performed to compare the current driver with PD and control groups on the measures of performance, and showed impairment in accuracy (U = 21.0 p = 0.01), driving reaction time (U = 17.0 p = 0.006), and the number of red lights missed (U = 24.0 p = 0.009). There was no significant difference between the simple reaction times. (U = 34.5 p = 0.12.)

Spearman’s rank correlation coefficient was

calculated for measures of driving ability against the rating on Webster’s scale in both the drivers and ex-drivers. This showed that severity of PD correlates with driving reaction time (r = 0.53 p = 0.026), accuracy (r = 0.78 p = 0.001) and simple reaction time (r = 0.63 p = 0.008). There was no correlation with the number of red lights missed. (r = 0.05 p = 0.44.) Age did not appear to be a significant influence on the dependent measures: Spearman’s rank correlation coefficient of age with accuracy, (r = -0.28 p = 0.2) the number of red lights missed, (r = -0.17 p = 0.3) and both driving (r = 0.40 p = 0.1) and simple reaction time (r = 0.15 p = 0.3) showed no significant correlation. Accuracy and driving reaction times correlated significantly (Spearman’s rank correlation coefficient = 0.55 p = 0.003).

Discussion

Attempts to study driving ability in PD, other diseases with motor impairment and with various medications pose several problems. Assessment of driving in a car in traffic may be ethically unacceptable and may not provide a reproducible test. The use of a driving simulator is one possible method of replicable assessment. Haakinen⁶ showed that psychomotor abilities measured in this way are closely related to accident-proneness. However, caution must be exercised in extrapolating from results obtained on the simulator to a real driving situation.

Two methodological problems need to be considered. Firstly, the PD patients whom we tested may have felt confident of their driving abilities and other PD sufferers who were less confident did not volunteer, thereby introducing an element of bias into the sample. Secondly, it is possible that subjects may have concentrated on one parameter of the test to the detriment of their other scores, although the significant correlation between accuracy and driving reaction time make this possibility unlikely.

In our use of the driving simulator, the group of PD drivers were impaired in measures of driving ability, and this impairment correlated with the severity of PD. However, the severity of PD itself is not the sole factor in deciding whether a patient is fit to drive, and it is likely that other factors are also important. Ritter and Steinberg⁷ found that PD patients were seldom involved in accidents when compared to the national rates. They therefore felt that PD patients showed a great measure of responsibility.

The effects of levodopa need to be considered. Many of the PD group commented that they had significant “on-off” effects from their medication, and that although they felt safe to drive at the time they were tested, there were times when they would not feel safe to drive, and would not do so. This would make the timing of any assessment of fitness to drive, in relation to the “on-off” status of the patient, crucial. Similarly, two PD patients were affected by dyskinesic movements during the test-

Controls					
Sex	Age	Accuracy	Driving reaction time	Simple reaction time	Red lights missed
M	38	18.8	0.47	0.31	0
M	53	24.0	0.57	0.37	0
F	50	24.5	0.49	0.45	1
F	59	21.5	0.73	0.70	0
M	55	24.8	0.61	0.39	0
M	56	18.2	0.50	0.33	0
M	61	13.3	0.61	0.33	0
F	61	19.3	0.66	0.40	0
M	63	26.7	0.56	0.43	0
M	65	27.6	0.73	0.46	0
Mean	55.9	21.9	0.59	0.41	0.1
95% Confidence limits	50.9–60.9	19.1–24.7	0.53–0.65	0.34–0.50	0–0.3

ing, and seemed to score less well than the other PD drivers, and in particular missed the highest number of red traffic lights. The pattern of driving may also be relevant: there is an obvious difference between a commercial traveller with a high daily mileage and a retired person who drives infrequently.

We have shown a correlation between driving ability (measured by driving reaction time and accuracy) and PD (measured by Webster's rating scale). The PD subjects in our study scored up to 12 on Webster's rating scale which represents mild (0–10) to moderate (11–20) disability. From our results it would seem that patients with moderate disability will require careful consideration regarding their safety to drive. The possible causes of this observed slowing require consideration. Marsden⁸ stated that people with PD complain that they require a conscious effort to complete straightforward daily activities which had been performed easily and automatically before they became ill, and that the basis for this is impairment of attention. He suggested that this may account for the tiredness and fatigue in PD. Bloxham *et al*⁹ suggested that one of the consequences of the dopamine deficiency in PD is a loss of definition of specific motor programmes which result in a decreased ability to activate them selectively from the available repertoire.

The difference in the means of the simulated driving reaction times of the PD patients and the controls is 0.13 s. If we disregard any difficulties with the external validity of the testing procedure and take this difference to be representative of a slowed reaction time when driving in a real situation, the practical significance of this when travelling at 30 mph would be an increase in the "thinking distance" of 1.6 metres from the "normal" of 9.1 metres (an increase of 18%). An alternative way of expressing this is for a PD driver to have the same stopping distance as a normal driver

travelling at 30 mph, the PD driver would need to reduce his speed to about 25 mph. This example illustrates the importance of pursuing the study of driving by means of this and other methodologies. The Parkinson's Disease Society are keen to do this, and also to promote aids for disabled drivers.¹⁰

According to our research, the best guide to a patient's fitness to drive is their score on Webster's rating scale; any patient with moderate disability (11–20) is likely to show an impairment of their previous driving skills. If there is further doubt about a particular individual, the clinician should advise the patient to submit themselves to a driving test organised by the Licensing Authorities.

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