

Identifying Pilots with Parkinson's Disease

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- BACKGROUND:** In 2012 the Australian Institute of Health and Welfare produced a report titled 'Dementia in Australia'.² The report noted that the number of people with dementia in Australia would reach almost 400,000 by 2020. Australia is a jurisdiction which does not impose a mandatory retirement age for pilots. With an aging population it was hypothesized that conditions such as Parkinson's disease (PD) were likely to be seen more commonly by the Civil Aviation Safety Authority (CASA). It was decided that this was an appropriate time to retrospectively study the data held by CASA.
- METHODS:** An interrogation of CASA databases was undertaken. Data was produced comparing percentage of Class 1 certificate holders over 60 yr of age against time. A cohort of pilots and controllers with PD was identified. The history of the cases was reviewed.
- RESULTS:** The study confirms that the pilot population is aging in line with population trends. Over a period from 1992 to 2012, 22 cases of pilots and controllers with PD were identified.
- DISCUSSION:** The study confirmed that PD will be of increased relevance over the next decade. Gaps between policy and practice managing past cases were identified. Updated guidelines have been published aiming to address the deficiencies identified in the study. Historically pilots and controllers have been able to maintain certification for an average of 3.75 yr. This information should be of benefit to clinicians, pilots, and controllers when considering occupation and treatment options.
- KEYWORDS:** CASA, aging, pilot, neurological impairment.

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A mandatory retirement age for pilots and controllers is applied by law in some jurisdictions. Australia does not have an upper age limit for pilot or controller certification. There has been a growing body of evidence that Australia is experiencing a demographic shift toward an older population, with resulting impacts on the health system likely to be of consequence. In 2012 the Australian Institute of Health and Welfare produced a report titled 'Dementia in Australia.' The report noted that based on projections of population aging and growth, the number of people with dementia in Australia would reach almost 400,000 by 2020.² The Civil Aviation Safety Authority (CASA) has sought to address the challenges posed by an aging pilot and controller population. Advice has been obtained from clinicians in relevant specialties regarding suggested changes to policy and practice. In the context of an aging population and no mandatory retirement age it was hypothesized that neurodegenerative conditions such as Parkinson's disease were likely to be seen more commonly by this aviation safety regulator in the future. It was therefore decided that this was an appropriate time to retrospectively study the data held by

CASA relating to this particular disease, which is known to have increased prevalence with aging.⁷

The policy that applied during the period from 2008 until 2012 stated the following: "Parkinsonism can be a manifestation of other diseases and such causes should be sought and dealt with. Parkinson's disease is a chronic, progressive disorder of primary Parkinsonism with no evidence of more widespread neurological involvement. The functional effects of Parkinsonism can be variable. A careful record of neurological deficits, including effect on common activities, should be made. This will serve both as a quantitative appraisal tool and for comparison in evaluating subsequent progression of the condition. A flight test is an essential component of evaluation. It should be

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the last of the tests performed and does not replace clinical assessment. Applicants may be assessed as fit for certification if there is no adverse effect of treatment such as postural hypotension or “on off” phenomena, and if the following features are adequately controlled: bradykinesia, rigidity, tremor, adjustment of center of gravity, voice quality, rapid scan eye movement. Significant sequelae relevant to aviation safety include altered color vision, dementia (late phenomenon), depression (early as reaction to diagnosis, or later as a primary phenomenon), “on off” phenomenon: abrupt but transient fluctuation in clinical state within the day, often as complication of levodopa therapy. Progression to incapacitating symptoms or signs is generally slow. Shortened validity of certification is required to facilitate monitoring of changes. Class 1 certificate holders may require 6 monthly review and restriction to duties ‘as or with copilot.’ All classes of medical certificate holders will require neurological review at least annually. Applicants receiving treatment who display “on off” phenomena will not be certificated to continue flight duties due to the likelihood of rapid onset of incapacitation within the time period of a typical flight.”

This study had several aims: to determine if the pilot population was aging in line with the general population, to assess the existing burden of Parkinson's disease in the Australian pilot and controller population, to assess how the extant Parkinson's disease policy had been applied to this population, and to assess the longitudinal progress of the cases identified.

METHODS

CASA maintains several databases of medical and demographic information. An electronic Medical Record System (MRS) is used by CASA and external designated aviation medical examiners to process applications for medical certificates and also to case manage pilots and controllers when there is a significant change in medical condition. CASA also has a Complex Case Management (CCM) meeting database. This database is a repository of cases reviewed by a panel of doctors. Conditions that are likely to impact negatively on certification are routinely reviewed at this meeting.

When a pilot or air traffic controller applies for a medical certificate, they are asked to provide consent for their personal medical information to be accessed and discussed for the purpose of certification. A clear and explicit consent is also signed, enabling CASA to carry out research so long as the outcomes are de-identified. This study was conducted within these parameters.

One component of this study intended to determine if the professional pilot population is aging in line with trends seen in the general population. An interrogation of the MRS database of certificate holders by age against class of medical certificate was undertaken. With some minor exceptions, all professional pilots in Australia must hold a valid Class 1 medical certificate. Data was produced comparing the percentage of Class 1 certificate holders over 60 yr of age against time.

The second component of this study intended to identify those pilots and controllers diagnosed with Parkinson's disease

and determine how they were subsequently managed. An interrogation of the CCM database was undertaken to identify those pilots or controllers who had been reviewed with the diagnosis of Parkinson's disease. Once these cases were identified, the MRS files for each case were reviewed in order to assess the longitudinal progress of the individual cases and to assess how the extant policy had been applied to each case.

RESULTS

The data obtained from the MRS database, shown graphically in **Fig. 1**, has demonstrated that the professional pilot population in Australia is indeed aging in line with the trends seen in the general population. Epidemiological studies in the medical literature suggest a prevalence of Parkinson's disease of around 0.5–1% of the population over 60 yr of age and 3–4% over 80 yr of age.^{7,13} CASA, therefore, expects that the numbers of pilots and controllers presenting for aeromedical risk assessment to steadily increase for the foreseeable future.

From 1992 to 2012, 22 pilots and controllers were reviewed following first notification to CASA of a diagnosis of Parkinson's disease. This is an average of one new case of Parkinson's disease reviewed per year. Based on the total number of professional pilots and controllers holding certificates during that period, the number of cases is less than expected. Possible explanations for this finding include: voluntary cessation of flying or controlling activities without notification to the regulator; database limitations in terms of coding, cases being managed without referral for complex case meeting review, or some other as yet unknown cause.

Of the 22 cases identified, 16 no longer had a current medical certificate. Of the 16 without a current medical certificate, 11 certificates time expired and 5 were either refused at application or cancelled during their validity period.

There were six active certificate holders recorded in the CCM database: five Class 2 certificate holders and one Class 1 certificate holder. One of the Class 2 certificate holders was currently suspended because of instability in their Parkinson's disease.

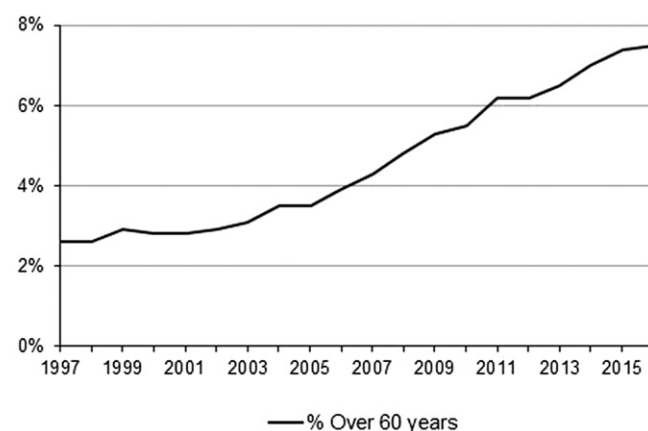


Fig. 1. Percentage of Class 1 applicants over 60 yr of age from 1993 to 2012.

There was limited investigation or surveillance in some cases because of their particular circumstances. Three cases were refused at first assessment by CASA. One case initiated cancellation of his medical certificate by requesting a flight test (prior to commencing any pharmacotherapy) on the basis of his own opinion that he was unfit. On average, applicants have been able to maintain their certification for 3.75 yr from the time the condition was diagnosed.

In terms of application of the extant policy to cases during the study period, all cases were reviewed by consultant neurologists without exception. Subsequent review was conducted annually by consultant neurologists in all cases. All of the reports produced from these consultations were reviewed. There were no vision assessments that were performed in order to assess for the impact of Parkinson's disease on visual function. Two cases were reviewed by a designated aviation ophthalmologist during the study period. In one case this was because the pilot was already being regularly reviewed for their macular degeneration and in the other case it appears to have been due to routine age-based testing. Although the policy stated; "A flight test is an essential component of evaluation," there is evidence that only six cases undertook the flight test required for the aeromedical assessment. Flying tests that were undertaken during the study period for licensing requirements were not included. Multi-crew restrictions were applied to medical certificates in seven cases.

DISCUSSION

A review of the notes associated with these cases demonstrated that past risk assessment has relied mostly on the treating neurologist's reports. The neurology reports have in general focused on the cardinal symptoms of Parkinson's disease and their control. Almost without exception the reports have been favorable to the applicant. A particular exception to this was seen in the case of an airline pilot who initiated cancellation of his certificate due to his own belief that he was not fit. In this case the neurologist's report was unfavorable. In the majority of cases the reports have remained favorable up until the time that medical certificates have expired.

Comments regarding assessment of the aeromedically significant non-motor aspects of the disease, such as mild cognitive impairment, dementia, depression, sleep disorders, autonomic symptoms, orthostatic hypotension, bladder disturbances, or vision impairment do not feature in most of the reports.⁵ In general, the reviewed reports were not structured in a way which would facilitate the recommendation of the extant guidelines, such that the assessments should serve as a quantitative appraisal tool and for comparison in evaluating subsequent progression of the condition.

Three cases underwent formal neuropsychiatric screening. In these cases the reports provide more detailed quantitative assessment, which would appear to address the aspirations of the guidelines more thoroughly in terms of providing for progressive assessment. The neurologist's undertaking the reviews

would most certainly have assessed for non-motor impairments due to the disease. They may have also made use of quantitative rating scales or scoring systems in their own records to monitor the progress of these patients. Unfortunately, this information was not readily available in the reports reviewed. It is a practical consideration that certificate holders may change doctors, doctors may retire, and different aeromedical assessors may review the same case from year to year. In the author's opinion, for a disease that is invariably progressive at variable rates in variable functional areas, obtaining data that would serve both as a quantitative appraisal tool and for comparison in evaluating subsequent progression of the condition is a necessity for informed aeromedical risk assessment. The clinical practice guidelines that resulted from this review aim to make this requirement clear.

Aviation medical specialists whose duties involve assessing such reports should be wary of comments regarding the tendency for slow disease progression when it is considered that at the time of diagnosis, mild cognitive impairment is noted in 15–20% of people even before dopaminergic therapy is commenced.¹ They might also question the indication for increasing numbers of Parkinson's medications being prescribed, given that levodopa remains first line therapy for motor symptoms and other classes of drug may be prescribed as motor complications arise.¹⁹ In the International Civil Aviation Safety Organization (ICAO) Manual of Civil Aviation Medicine the following observation is made with regard to the medical management of Parkinson's disease: "Therapeutic agents, including carbidopa/levodopa, may be acceptable, while the dopamine agonists are unacceptable due to their sedative potential."¹¹ A search of the medical literature produces several articles which suggest that dopamine agonist therapy is associated with a higher risk than levodopa for developing hyper-somnolence and sudden onset of sleep, which support the statements made in the ICAO Manual of Civil Aviation Medicine.^{6,10,12} For this reason the clinical practice guideline that was produced following this review states that dopamine agonist therapy is an unfavorable feature for certification.

Various clinical rating scales have been developed and validated for assessing patients with Parkinson's disease. The Unified Parkinson's Disease Rating Scale (UPDRS) was originally developed in the 1980s and became one of the most widely used clinical rating scales for Parkinson's disease. The UPDRS was reviewed and modified to create the Movement Disorder Society (MDS) UPDRS in 2008.⁹ The MDS UPDRS has four parts, namely: I) Nonmotor Experiences of Daily Living; II) Motor Experiences of Daily Living; III) Motor Examination; and IV) Motor Complications. In the author's opinion, the use of the MDS UPDRS, or equivalent validated scales, would be ideal in satisfying the intent of the policy that applied from 2008 until 2012 in terms of quantified longitudinal assessment. The clinical practice guidelines recommend that the MDS UPDRS or equivalent scales be considered in the assessment of pilots and controllers with Parkinson's disease.

One of the most concerning findings of this review is that, despite the extant policy stating that a flight test is an essential

component of evaluation, only a minority of certificate holders underwent flight test assessment. Two of the audit cases were air traffic controllers. Of the remaining 20 cases only 6 show evidence of having completed this assessment.

All pilots passed the flight test in those cases where it was performed. The authors are not aware of any medical literature which has assessed the performance of pilots with Parkinson's disease on flying tests. There is evidence in the literature regarding driving performance. The results seen in our audit are inconsistent with what would be expected if compared with the literature regarding driving tests. A study of driving performance of 25 patients with idiopathic Parkinson's disease and 21 age matched controls found that more than half of the drivers with Parkinson's disease would not have passed a state based driving test.¹⁸ Another study found that drivers with Parkinson's disease made more navigation and safety errors than neurologically normal drivers on a route-following task that placed demands on driver memory, attention, executive functions, and visual perception.¹⁵ The reason for the 100% pass rate for flying tests in our cohort is uncertain. It may be that the flight test profile was so thoroughly practiced over many years that the impairments caused by the disease were able to be compensated for by ingrained behaviors and procedures. A flight test profile that specifically assesses for potential impairments of Parkinson's disease such as cognitive dysfunction, impaired 'g' tolerance, delayed reaction time, motor impairment, and impaired visual function has been devised subsequent to this review.

The extant policy recommended assessment for rapid scan eye movement and altered color vision. In our cohort there is no evidence that the potential visual impairments associated with Parkinson's disease were assessed. Evidence exists of visual dysfunction at several levels of the visual pathway in Parkinson's disease. This includes psychophysical, electrophysiological, and morphological evidence of disruption of the retinal structure and function, in addition to disorders of 'higher' (cortical) visual processing. There is also evidence at the functional level of impairment of visual acuity, contrast sensitivity, color vision, and motion perception.³ Drivers with Parkinson's disease have been noted to perform worse than controls in low contrast conditions with poor vehicle control and higher risk for crashes, which were primarily predicted by decreased visual perception and cognition.¹⁴ Not all of the potential visual impairments that can be caused by Parkinson's disease are easily assessed using office-based tests and examinations. Subsequent to this review more specific guidance was published reinforcing the need for detailed ophthalmological assessment. By necessity, impairments of motion perception must be assessed for as part of the flight test.

Evidence available in the literature shows that drivers with Parkinson's disease are six times more likely to cease driving than age matched controls in a 2-yr period.¹⁶ In our study the majority of certificates have expired without action by CASA. Voluntary withdrawal due to disease progression is a plausible explanation for the high dropout rate seen in our database. It might be argued that voluntary withdrawal is a natural mitigation for the aeromedical risk of this particular disease. In this

context it is worth noting that despite the impaired driving performance noted in the literature, the same literature indicates that this impairment is not reflected in accident statistics for drivers with Parkinson's disease.¹⁶ It might also be argued that the extant policy for assessing cases or the way the policy was implemented allowed certificate holders to continue beyond the point that they may have been safe to hold a certificate.

Our finding that in most cases certificate holders are able to maintain their certificates for 3.75 yr from the time of diagnosis parallels some significant findings reported in the medical literature. A study that followed the natural history of treated Parkinson's disease in an incident, community-based cohort showed that median time to Hoehn Yahr Stage 3 (HYS 3) from diagnosis was 3.8 yr.⁸ HYS 3 was chosen as an end point in this particular study because of the association of onset of axial instability with a marked deterioration in quality of life measures. In terms of evolution of cognitive dysfunction, in a community-based cohort of 126 patients with incident Parkinson's disease, 10% met DSM IV criteria for dementia by the time of follow-up at 3.5 yr. In addition, a further 57% showed some degree of impairment on neuropsychological testing, hence two-thirds of the cohort were cognitively impaired at 3.5 yr.¹⁷

The clinical practice guidelines published by CASA subsequent to this review, for new cases, require;

1. Neurologist report with MDS UPDRS or equivalent;
2. Neuropsychological assessment;
3. Ophthalmology review; and
4. Flight test.

It is recommended that the applicant undertake the assessments in this order and to provide the reports as soon as possible to CASA. This recommendation is made in order to avoid unnecessary expenditure of time and money if the reports are unfavorable. At subsequent reviews only the neurologist report with rating scale and flight test are mandatory. The requirement for neuropsychological assessment and ophthalmology review is to be assessed on a case by case basis depending on progress and duration of the disease. Pilots and controllers are advised to ground themselves and report to CASA, or their medical examiner, if there is a change in their condition or treatment.⁴

Parkinson's disease is a progressive disease which culminates in a constellation of non-motor and motor symptoms. The policy that applied during the final 5 yr covered by the retrospective study described in this paper should have been sufficient to enable identification of cases of aeromedically safe Parkinson's disease. This study has shown that the extant policy was incompletely applied. Following this study Clinical Practice Guidelines were published by CASA in order to provide more detailed and specific advice for assessing pilots and controllers with Parkinson's disease.⁴ The guidance material aims to more clearly enunciate a combination of objective and subjective assessments that together provide a holistic understanding of the individual's functional status and enables an aeromedically determined risk management decision. It is hoped that better communicating and standardizing this

process will help to identify warning signs when pilots (and controllers) are beginning to suffer significant impairment, while at the same time helping to maintain them operating safely for as long as reasonably possible.

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