Emotion recognition impairment in Parkinson´s disease patients without dementia

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ABSTRACT

Purpose: Previous research has shown dementia and mild cognitive impairment to be present in some Parkinson's disease (PD) patients. Nevertheless, it is still not clear whether the impairment found in PD patients also comprises a facial emotion recognition deficit, nor it is whether this possible deficit is independent of the cognitive impairment or not. The aim of this study is to assess the presence of emotion recognition deficits in a sample of PD patients with normal cognitive abilities evaluated with several cognitive tasks widely used to detect cognitive impairment on this kind of patients

Method: 40 non-demented (MMSE scores >25) PD patients and 19 healthy seniors matched on demographic characteristics took part in the study. All of them were evaluated with a neuropsychological battery including tests aimed to assess the cognitive domains mainly affected by PD, as well as a facial emotion recognition task.

Results: the scores in the 6 tasks that showed significant differences between PD and control groups according to a series of t-tests analyses were introduced in a sequential logistic regression analysis that confirmed the existence of a facial emotion recognition deficit in PD patients after controlling for demographic and cognitive characteristics of the participants.

Conclusions: Although none of the PD patients fulfilled criteria for dementia, many of them appeared to present deficits on recognition of facial emotions. This task should therefore be incorporated into future research to study the full range of early cognitive dysfunctions and non-motor symptoms presents in PD patients, and inclusion of this task in assessment protocols should be considered.

INTRODUCTION

Parkinson´s disease (PD) is a progressive neurodegenerative disorder typically diagnosed on the basis of the presence of motor symptoms (bradikinesia, rigidity and resting tremor). Those symptoms are the main consequence of the degeneration of dopamine neurons in the sustancia nigra [1]. However, other non-motor characteristics like hyposmia [2], sleep disorders, anxiety, depression, memory, language, executive function impairments and even dementia [3-5] are also present in many PD patients. Recent neuropathological findings have found that PD related pathology may extend to other brain areas including the dorsal motor nucleus of the vagus, the olfactory nuclei, the raphe nuclei, locus coeruleus, the reticular formation and some cortical regions [6] which could explain these non-motor symptoms. In addition, other symptoms like verbal and nonverbal communicative deficits remain partially unstudied, although they seem to be present in many PD patients. Thus, PD patients have been shown to present a reduced ability to produce spontaneous emotional expressions and co-speech gestures [7], as well as a specific impairment in recognising facial emotions [8,9]. The results of these studies suggest that the original description of PD should be updated into the concept of a multisystemic neurodegenerative disorder with multiple representations including non-motor symptoms such emotion recognition impairment [10].

The normal processing of facial emotions requires two different processes: perception and emotion recognition. Several brain areas situated in cortical and subcortical regions are related to the recognition of emotions from facial expressions, including the occipito-temporal cortex, the amygdala, the orbitofrontal cortex, the basal ganglia and the right parietal cortex [11]. Some of these areas, namely the nigrostriatal system, the amygdala and the insular cortex, have been demonstrated to be affected as a result of the PD-related pathology [6]. Recent neuroimaging studies have pointed out

the relationship between gray matter loss in the orbitofrontal cortex and facial emotion recognition impairments in early PD patients [12]. Furthermore, a relationship between facial emotion categorization impairments and strategies of facial expression scanning has been found in PD patients [5]. In contrast, other studies have failed to demonstrate the existence of impairment in facial emotion recognition tasks in PD patients compared to healthy controls [11].

Previous research represents an important contribution to our knowledge about non-verbal deficits related to PD and has provided evidence for possible neuropathological substrates of these deficits. Thus, if only purely cognitive abilities are assessed, some information about non-motor symptoms related indirectly with cognitive process, like facial emotion recognition, could be ignored. Therefore, it seems necessary to design tasks that evaluate this nonverbal aspect of the patients that can affect their cognitive abilities and social behaviour in order to establish the full range of deficits associated to the disease and adequate the therapy. The aim of this study was to assess the presence of emotion recognition deficits in a sample of PD patients with apparently normal cognitive abilities assessed by means of several cognitive tasks widely used to detect cognitive impairment on this kind of patients. The appearance of some degree of emotion recognition impairment in our sample, even after demographic and cognitive characteristics have been controlled, would point out the existence of a specific and independent deficit related to facial emotion processing.

METHOD

Participants

A group of 40 regular follow-up PD patients (14 females) with a mean age of 69.62 (range 55-85) and a group of 19 healthy seniors (8 females) with a mean age of 74.31 (range 57-81) participated in the study. All of them had Mini

Mental State Examination [14] (MMSE) scores within the normal range (between 27 and 30) according to the Escribano-Aparicio norms for Spanish population [15]. The two groups of participants were matched on demographic characteristics (see Table 1). PD patients had been diagnosed according to the UK Parkinson´s Disease Brain Bank criteria [16], prior to their participation in our study. All of them were studied on their dopaminergic treatment (Levodopa, agonists or both). Only patients that referred no subjective cognitive complaints or psychiatric and depressive symptoms (assessed with The Hospital Anxiety and Depression Scale [17] (HAD) took part in the study. Prior to the presentation of the experimental tests, the patients underwent a neuropsychological examination including the Tower of Hanoi, Stroop, and phonological (words beginning with the letter "p"), semantic (animals) and alternate fluency (a word beginning with the letter "p" and then animals, alternating both categories), as well as several tasks of the Barcelona Test-Revised [18], verbal and visual memory, attention, orientation, verbal comprehension and abstractions, to rule out dementia. Only native Spanish speakers with no history of alcohol abuse or neurological or psychiatric disorders other than PD were included in the study. Informed consent was obtained from all the participants.

Stimuli and tasks

The two groups of participants went through a test battery including facial emotion recognition tasks as well as other cognitive tasks frequently used with this kind of patients.

- Facial emotion recognition: participants were asked to categorize the emotions expressed in 18 photos of faces (half male, half female) selected from the MacBrain Face Stimulus Set [19]. The faces could express one of six different emotions: happiness, sadness, anger, surprise, disgust or fear.

In order to rule out severe cognitive impairment or dementia, we selected several tasks to assess other capacities known to be affected in PD patients even at the early stages of the disease. Both standardized tests and newly designed tasks were combined in order to examine six cognitive domains:

- Executive functions: the Go-nogo paradigm and Trail Making Test B (TMT-B), as well as, phonological (letter "F") and semantic ("tools") and actions fluency tasks were used.
- Memory: participants were orally presented with a list of ten words [20]. Immediately afterwards they were asked to recall as many words as possible, and once again after several minutes. In order to assess visual working memory, a grid including an increasing number of pseudorandomly distributed dots was presented for 10s. Then, the participant was asked to recall and mark the position of the dots. The task began with two dots and finished when the participant failed two consecutive items. This task was designed based on the visual memory task included in Wechsler´s. [21]. In addition, verbal working memory was assessed using forward and backward versions of the digit span task [18].
- Attention: Trail making-A (TMT-A) and a visual search task where the participant had to mark the number 3 every time it appeared in a grid including randomly distributed figures from 1 to 9, were used to assess attention. This task was an adaptation of the attention task from the Barcelona test [18].
- Visuospatial and constructive abilities: visuospatial abilities were assessed with dot and cube counting tasks from the Visual Object and Space Perception test [22] (VOSP). Participants were asked to count dots or cubes pseudorandomly distributed in a sheet of paper. Constructive abilities were

examined by means of the cube copy task from the Montreal Cognitive Assessment test [23] (MOCA)

- Language: patients were asked to name 15 drawings of actions [24] using the infinitive form of a verb, and to produce the names of the famous persons from photographs of five national and five international celebrities.

Procedure

PD patients were recruited between October 2009 and March 2010 and completed the neuropsychological assessment in a soundproof room of the Álvarez-Buylla Hospital in Mieres, Asturias. Patients were evaluated in two sessions of about an hour that were scheduled 4 or 5 days apart. Each participant was run through the assessments individually.

Statistical analysis

The scores of PD and control participants were compared by means of t-test analyses. Action and semantic fluency, visual search, action and famous faces naming as well as facial emotion recognition showed significant differences between the two groups. Then a sequential logistic regression analysis was conducted in order to test whether a facial emotion recognition deficit was apparent in our PD sample after controlling for demographic and cognitive characteristics of the participants.

RESULTS

The mean (SD) scores of the two groups of participants in the neuropsychological battery are presented in Table 2. A summary of the results of the analysis is presented in Table 3.

A sequential logistic regression analysis was conducted in order to establish whether facial emotion recognition differentiated between PD and healthy controls after

controlling for demographic and cognitive characteristics of the participants. The first block of the analysis included participants' socio-demographic characteristics, including age, sex and education ($\chi^2(3)=4.48$, $p=.21$; R^2(Nagelkerke)=0.1). In the second block ($\chi^2(4)=17.63$, $p=.001$; R^2(Nagelkerke)=0.44), scores obtained in the cognitive tasks that appeared to have a significant influence according to the results of the t-test, namely semantic and action fluency, action naming and visual search task attention, were introduced in the analysis. The third block ($\chi^2(1)=10.57$, $p=.001$; R^2(Nagelkerke)=0.6) included the scores obtained in the famous faces naming task, and finally, scores obtained in the facial emotion recognition task were included in the fourth block ($\chi^2(1)=19.19$, $p<.001$; R^2(Nagelkerke)=0.82). A summary of the results of the logistic regression is presented in Table 4. The final block of the regression showed a significant effect of the emotion recognition task even after controlling for all the other participants' characteristics. Moreover, the model was able to accurately distinguish between healthy and PD participants in 91.5% of the cases. Thus, 94.7% of the healthy participants were classified correctly, whereas only 4 of the 40 PD participants were misclassified.

In order to provide a general description of the presence of cognitive deficits in the sample of PD patients studied, their scores were categorized as pathological if they were at least two standard deviations below the mean score of the control sample. Following this recent guidelines [25] 23 (57.5%) of the 40 patients were classified as cognitively intact, although 13 of them exhibited impaired emotion recognition. Taking into consideration the whole group of patients, 26 of them had an emotion recognition deficit (see Figure 1).

DISCUSSION

Only a few studies aimed to assess the presence of emotion recognition impairment in Parkinson's disease patients have been conducted, and their results are far from being consistent. Therefore, carrying out an experiment aimed to detect emotion recognition deficits in PD patients with normal cognitive abilities was considered necessary. A sample of 40 PD patients and 19 healthy seniors were assessed with an extensive neuropsychological battery exploring all cognitive domains mainly affected on PD such as executive functions, verbal fluency, attention, visuospatial abilities, memory and language to rule out dementia and severe cognitive impairment that could affect their performance on an emotion recognition task. Besides, caregiver information about cognitive functioning and the neurologist subjective criteria were also taken into account. Nevertheless, our assessment revealed the existence of some degree of cognitive deterioration in 42.5% of the patients, whilst 57,5% was considered as cognitively intact. On the basis of their results in the different tasks, the patients were classified as cognitively impaired or not. The cognitive impairment label was applied when their scores were two SD below the control mean. According to this criteria [22], 27 (42.5%) were considered to suffer from cognitive impairment, a rate consistent with those obtained in previous studies [29]. It should be noted, however, that many of the allegedly non-cognitively impaired patients, presented a facial emotion processing deficit, to the point that impaired scores on this task were evenly distributed through the impaired and intact patient subgroups.

Furthermore, our data support the notion that some PD patients show an emotion recognition deficit in absence of other cognitive deficits that could explain it. This results suggest that the emotion recognition deficit is a different entity independent from other cognitive impairments. The two tasks aimed to assess face processing (famous face naming and emotion recognition from facial expressions) revealed the existence of

deficits not directly related to those cognitive capacities. Moreover, a sequential logistic regression showed that facial emotion recognition was able to distinguish between healthy and PD participants after demographic and cognitive characteristics of the participants had been controlled. This deficit had already been described in previous research [8,9], and possible links with early dopamine depletion in the nigrostriatal system [27] or atrophy of the orbitofrontal cortex and amygdala[10] have been suggested to explain it. A number of studies have described mild executive dysfunction in early PD patients and the role of impaired cortico-basal connections in determining them [28]. However the fact that we have found facial emotion recognition deficits in PD patients with normal scores on executive function tasks argues against ascribing the emotional deficit to impaired cortico-basal connections. In contrast, our results are in line with data indicating that the amygdala could be damaged early during the course of Parkinson's disease [12].

In conclusion, the present study revealed the existence of an emotion processing impairment measured with facial emotion recognition in PD patients with normal global cognition and without subjective cognitive complaints.

According to our results, the assessment of face emotion recognitions should be incorporated to future research aimed to study the full range of non-verbal deficits present in PD patients in absence of pure dementia or severe cognitive impairment, and inclusion in assessment protocols should be considered in order to achieve a comprehensive description of the cognitive abilities present in PD patients.

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