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REVIEW ARTICLE

Cognitive functions in patients with panic disorder: a literature review

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Objective: To conduct a review of the literature on the possible neuropsychological deficits present in patients with panic disorder.
Methods: We performed a systematic review and search of the PubMed, ISI and PsycInfo scientific databases, with no time limits, using the following key words: cognitive, function, panic, and disorder. Of the 971 articles found, 25 were selected and 17 were included in this review. The inclusion criterion was at least one neuropsychological assessment task in patients with panic disorder.
Results: The number of publications has grown gradually, especially those assessing executive functions, corresponding to the neurobiological model most widely accepted. Of all the functions evaluated, these patients had lower performance in memory tasks and higher performance in affective processing tasks related to the disorder. However, these data require further investigation due to the high rate of comorbidities, the small sample sizes of the included studies and little standardization of instruments used.
Conclusion: The results showed a greater occurrence of deficits in memory and enhanced affective processing related to panic disorder.

Keywords: Panic disorder; cognitive function; memory; affective processing; executive functions

Introduction

Panic disorder (PD) is characterized primarily by the presence of recurrent and unexpected panic attacks, followed by at least 1 month of persistent concern about other attacks, the possible consequences of attacks and a significant behavioral change related to the attacks. For a diagnosis of PD, the panic attacks cannot be better accounted for by another mental disorder, by physiological effects resulting from the use of substances or by other medical conditions, such as hypothyroidism.[1]

Regarding the prevalence of PD, a study found a lifetime rate of 1.6% and an annual rate of 1% in the city of São Paulo. However, this was not a representative sample of the Brazilian population.[2] Nevertheless, the annual rates are similar to those presented by the National Comorbidity Survey Replication, which estimated the prevalence of PD to be 5% in a lifetime and 1% annually in a representative sample of the U.S. population.[2]

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Neurobiology of panic disorder

The first studies that evaluated the neurobiology of anxiety used animal models because the behaviors of escape, fear and avoidance presented in these disorders are similar to certain responses presented throughout animal phylogeny, such as increase in heart rate and release of glucocorticoids when faced with adverse situations. However, some limitations, such as the inability to verbalize symptoms, resulted in a need for improved research models.[3] Thus emerged the current models of research, which have focused on the prevention of mental disorders due to their chronic and progressive aspects. Notable research lines include growing interest in neuropsychology and neuroimaging in an attempt to construct a cognitive profile of these populations.[2]

The neurocircuitry of fear includes two pathways for processing of sensory information. The shorter path consists of the rapid spread of autonomic and behavioral responses in potentially hazardous situations. In this case, the major regions involved are the anterior thalamus and the central and lateral regions of the amygdala. The latter is, in particular, the coordinator of this process because it triggers regions that themselves emit responses. In the longer path, the information

passes through several regions, including the cortex, which allows for a more refined analysis of inputs.[3]

In the case of PD, the hypothesis is that the neurocircuitry would result in dysregulated activation and coordination with increased subcortical activity and consequent neuroendocrine activation, both behavioral and autonomic.[3] Neuropsychological assessment can ratify or call into question the prevailing neurobiological model, because if cerebral regions are altered in PD, this would be expected to generate cognitive and behavioral responses accordingly.[4]

Neuropsychological assessment

Neuropsychological assessment has several objectives, such as identifying and describing possible changes in cognitive function. An evaluation may be recommended in a variety of cases, such as in patients who sustained an injury (e.g., traumatic brain injury or stroke) or in patients who are experiencing emotional or behavioral changes.

A detailed description of the different cognitive functions contributes to the establishment of more accurate diagnoses and prognoses, especially in cases where no functional changes are detected in neuroimaging studies. Furthermore, this description can assist in follow-up of individual cases when periodic reevaluation is recommended. Finally, this description contributes to a better understanding of the relationship between brain and behavior, demonstrating in practice what is theoretically established.[4]

The importance of establishing a relationship between neuropsychology and mental disorders arises from the need for more reliable and objective data about the abilities and deficits related to these disorders. As our behavioral and cognitive responses correlate with substrates and neural networks, when conducting a neuropsychological evaluation, we obtain a quantitative and qualitative picture of the workings of different cognitive functions and their related neural networks.[4] In the case of PD, few studies have been published; therefore, there is still uncertainty as to which cognitive functions could be affected by the disorder. The cognitive functions expected to be most affected are those related to regions involved in the fear network, i.e., the frontal cortex and limbic regions in particular. This would predominantly involve executive functions and emotional processing.

Understanding these relations in PD could lead to the development of better interventions.[5] These interventions may pertain to the field of neuropsychology, in the development of neuropsychological rehabilitation strategies, or even to the field of psychotherapy, enabling development of psychotherapeutic interventions that could be guided according to the cognitive profile of this group.

Thus, the objective of this study was to conduct a literature review of studies that included neuropsychological evaluations in patients diagnosed with PD, with or without agoraphobia, to investigate possible cognitive changes in this population.

Methods

A literature search of the PubMed, ISI Web of Knowledge and PsycInfo databases was conducted using the following terms: cognitive, function, panic, and disorder. The survey was conducted in August 2012; no time limits were set for any database.

A total of 971 references were found (315 in PubMed, 575 in ISI Web of Science, and 81 in PsycInfo). Of these, 45 articles were in a language other than English and 96 were duplicates, and were therefore excluded. This left 833 references for abstract analysis. Twenty-five articles were selected and recovered, of which only 17 were ultimately included. We excluded articles that only conducted neuroimaging or when the focus of neuropsychological assessment was a psychiatric disorder other than PD. Only articles describing neuropsychological assessment of PD patients, with or without agoraphobia, were included in this review. Studies were required to include at least one neuropsychological assessment task.

Data were stratified by functions evaluated: general intellectual functioning, memory, attention, executive function, psychomotor abilities and processing speed, verbal fluency, and affective processing measured in response to faces and words.

Results

The results of our literature review are summarized in Table 1.

General intellectual functioning

Overall cognitive functioning scores map a broad area and specify the patient's overall cognitive functioning. They are used to provide a rapid, initial assessment of the patient rather than a detailed analysis.[4] Only four articles examined general intellectual functioning; three of these used the Wechsler Adult Intelligence Scale (WAIS-R). The other study used Raven's Colored Progressive Matrices. The results were different in each article.

The first study[6] used four subtests of WAIS-R that assessed the verbal vs. performance IQ measures, as well as the full scale IQ, of patients (n=25) and compared them with a control group (n=25). The results showed lower performance on the picture completion subtest by patients with PD. In another article, patients with PD (n=69) scored approximately 10 points lower in verbal, performance and full scale IQ scores when compared to the control group (n=19).[7] Another study used four subtests of the WAIS-R and found lower scores in the block design subtest, which measures visuospatial constructional ability. This difference was common to patients with social phobia (n=18) and patients with PD (n=18) when compared to controls (n=16). However, the authors noted that there was no significant difference in the similarities subtest, which shows that this difference was not consistent.[8] The last study did not find any difference between the control group (n=15) and the other two groups, patients with PD with agoraphobia

Table 1 Summary of the studies included in the review

Study	n	M/F	Age	GIF	Mem	Att	EF	PAPS	VF	APFW	Neuropsychological Assessment Instruments	Results
Castillo et al. (2010)[5]	24 PD 24 C	13/11 13/11	30.9 30		X	X	X				- Digit span (DS) - Block Design - Stroop - Rey-Osterrieth Complex Figure Test (RCFT) - Facial Recognition Test - Word list, free and cued recall	Patients with PD showed deficits in executive functions, attention regarding the selection of relevant stimuli and working memory. Global scores for memory, attention and executive functions were lower than in the control group.
Lucas et al. (1991)[6]	25 PD 25 C	04/21 04/21	34.7 35	X	X						- Wechsler Memory Scale (WMS) - Selective Reminding(SR) - Benton Visual Retention Test (BVRT) - Four subtests of WAIS-R: Picture Completion, Vocabulary, Block Design, Similarities	Patients showed deficits in both functions evaluated. With respect to general intellectual functioning, their scores were lower in performance tests. PD patients also showed deficits in visual memory.
Gladsjo et al. (1998)[7]	69 PD 19 C	37/32 /	40.6 42.8	X	X	X		X	X		- Some subtests of the WAIS-R battery: DS, Vocabulary, Information, Arithmetic, Similarities, Picture Completion, Block Design, Digit Symbol - Verbal Fluency - California Verbal Learning Test (CVLT) - Continuous Visual Memory Test (CVMT) - Visual Selective Reminding Test (VSRT) - Warrington Recognition Memory Test (RMT) - Digit Vigilance - Trail-making test (TMT) - Finger Tapping Test	Of all the functions evaluated, the authors found deficits only in general intellectual functioning among patients with PD, who scored nearly 10 points lower than the control group in the verbal aspect, in performance and in total score. Memory, attention, psychomotor skills, processing speed and verbal fluency were preserved.
Asmundson et al. (1995)[8]	18 PD 18 SP 16 C	10/8 13/5 9/7	35.4 38.4 34.9	X	X	X	X	X			- Four subtests of the WAIS-R battery: Vocabulary, Similarities, Block Design, Picture Completion - CVLT - BVRT - TMT - Digit Cancellation Test (DCT)	Patients with PD exhibited deficits in processing speed and short-term memory free recall. The authors found a possible deficit in visuospatial ability, but this proved inconsistent. Attention, executive functions and visual memory were preserved.
Boldrini et al. (2005)[9]	25 OCD 15 PD 15 C	15/10 6/9 7/8	32.7 35.9 29.1	X	X		X				- Wisconsin Card Sorting Test (WCST) - Controlled Oral Word Association (COWA) - RCFT - Facial Recognition Test (BFRT) - Corsi Block Tapping Task (CBT) - DS - Buschke-Fuld Selective Reminding Test (SRT) - Raven Coloured Progressive Matrices (RCPM)	The authors only found deficits in spatial memory in patients with PD. General intellectual functioning and executive functions were preserved.
Kaplan et al. (2006)[10]	22 PD 22 C	7/15 7/15	36.2 36.9		X	X	X	X		X	- Two-subtest version of the Wechsler Abbreviated Scale of Intelligence - Seven subtests from the Cambridge NeuropsychologicalTest Automated Battery (CANTAB) - Spatial Working Memory (SWM) - Pattern Recognition Memory (PRM) - Spatial Recognition Memory (SRM) - Delayed Match to Sample (DMTS) - Rapid Visual Information Processing (RVIP) - Cambridge Gamble Task - Affective Go/No-go Task	Patients with PD showed no deficits in any of the functions evaluated. Memory, attention, executive functions, psychomotor skills, processing speed and processing affective were preserved.
Purcell et al. (1998)[11]	30 OCD 30 PD 20 DEP 30 C	20/20 6/24 8/12 12/18	40.6 38.9 37.5 40.8		X	X	X				- CANTAB - Spatial Span - SWM - Tower of London Planning Task - DMTS - Pattern Recognition - Spatial Recognition - Intradimensional-Extradimensional (ID-ED) Set Shift	The authors found that memory, attention and executive functions were unchanged in PD patients.

Continued on next page

Table 1 Continued

Study	n	M/F	Age	GIF	Mem	Att	EF	PAPS	VF	APFW	Neuropsychological Assessment Instruments	Results
Dratcul et al. (1998)[12]	14 PD 7 C	4/10 2/5	32.4 35.1		X	X		X			- Digit Cancellation - Symbol Copying Test (SCT) - Digit Symbol Substitution Test (DSST) - DS - Free Recall	The authors found alterations only in relation to memory (both immediate and delayed recall) in PD patients. Attention and executive functions were preserved.
Airaksinen et al. (2004)[13]	33 PD 32 SP 7 GAD 16 OCD 24 SPEC 175 C	7/26 10/22 2/5 4/12 8/16 89/86	43.6 38 41.7 35.7 43.2 43.9		X		X	X	X		- Episodic information to be remembered consisted by 32 neutral words -according to norms established by Nilsson (1973) - Word Association Test - TMT	The authors found deficits in episodic memory and executive functions in patients with PD. However, aspects of psychomotor skills, processing speed and verbal fluency were preserved.
Gordeev (2008)[14]	93 PD 36 C	30/63 12/24	31.2 30.1		X	X					- Münsterberg Test - Schulte tables - Short-term memory was tested for words	The authors found memory deficits with regard to words and numbers memory and also in attention, as regards selectivity and stability of attention.
Lautenbacher et al. (2002)[15]	21 PD 21 DEP 20 C	66%F 57%F 60%F	30.5 39 34.6			X					- Gesichtsfeld-/Neglectprüfung test of the Testbatterie zur Aufmerksamkeitsprüfung (TAP) - Signal Detection subtest of the Wiener Test system	The authors evaluated the attention function and found deficits in divided attention and preservation of selective attention.
Gorini et al. (2010)[16]	31 PD 31 C	7/24 12/19	35.52 30.23					X			- C-G Arena, a desktop-based computer-generated virtual space created to investigate place-learning abilities in humans	With regard to psychomotor skills and processing speed, the authors found changes in time and distance traveled to find the target, which was the goal of the task. However, these changes were characteristic of a subset of patients (older and longer duration of PD).
Lundh et al. (1998)[17]	30 PD 30 C	11/19 11/19	34.1 33.1							X	- Study 1:Black and white photographs of 80 persons (40 men, 40 women) were taken from a larger material originally used by BaÈckman (1991). - Study 2: The photographs t used were the same as in Study 1 and in the earlier studies by Lundh and Oèst (1996a, 1996b)	The function of affective processing demonstrated that patients with PD showed bias for safe faces, but not to critical faces.
Reinecke et al. (2011)[18]	23 PD 22 C	70%F 13%F	28.6 26.2							X	- Facial Expression Recognition task - Faces Dot Probe task - Emotional Stroop task - Self Beliefs task	On assessment of affective processing, the authors found that patients with PD have greater vigilance to fearful faces, thus showing a bias for faces.
Neidhardt et al. (1998)[19]	60 PD 60 C	31/29 27/33	34 34.3							X	- Sixty words with either positive nor negative valence from two semantic categories (panic-related vs. no-panic-related) formed four word classes.	The authors evaluated affective processing of PD patients and found better performance for face recognition.
Pauli et al. (1997)[20]	15 PD 15 C	4/11 4/11	35.5 35.3							X	- Two types of word sets were relevant for this study: 40 body-related and 40 nonsomatic words. Stimulus words were written in black lowercase letters on a white background and were presented by a Kodak Carousel S-AV 2000	On assessment of affective processing, the authors found that patients with PD exhibit better processing for words that are related to bodily sensations.
Van den Heuvel et al. (2005)[21]	18 OCD 15PD 14 HYP 19 C	6/12 8/7 12/2 10/9	33.4 33.7 40.6 30.3							X	- Stroop	The authors evaluated affective processing with respect to words and found that patients with PD showed greater attention to information related to the disorder.

APFW = affective processing to faces and words; Att = attention; C = healthy control subjects; DEP = depression; EF = executive function; F = female; GAD = generalized anxiety disorder; GIF = general intellectual functioning; HPC = hypochondriasis; M = male; Mem = memory; OCD = obsessive-compulsive disorder; PAPS = psychomotor abilities and processing speed; PD = panic disorder; SP = social phobia; SPEC = specific phobia; VF = verbal fluency.

(n=15) and patients with obsessive-compulsive disorder (n=25).[9]

These differences may be related to the inhomogeneity of the paradigms used for assessment; although three of the studies used the same measurement instrument, there was a difference in the number and type of selected subtests.

Memory

Memory is fundamental to perception because, without it, we do not recognize people or representative objects of our history.[22] Most of the articles evaluated different aspects of this function, such as working memory, long-term memory and visual memory.

Of the 10 studies, only three did not find deficits in memory.[7,10,11] Another two identified impairment in one aspect and preservation of another.[6,8] In one study, patients with PD (n=18) or social phobia (n=18) had a significantly lower performance in total free recall when compared to the control group (n=16). However, the author notes that this finding may be related to loss of interest, fatigue, some other mediating factor or a state of depression or anxiety, which could have generated a bias in the results.[8] In another study, patients with PD (n=25) performed worse than controls (n=25) in visual memory tasks but not in verbal memory or concentration.[6]

The five remaining articles described differences in other areas of memory. In one study, there was impairment of both working memory and explicit memory in patients with PD (n=14) as compared with a control group (n=7). However, the authors emphasize that such deficits may be related to a high level of excitement and anxiety in patients at the time of task execution. Excitement and anxiety could lead to a loss of selective attention, which mediates the process of encoding information and support received.[12] Another study found spatial memory impairment in patients with PD with agoraphobia (n=15) and patients with obsessive-compulsive disorder (OCD) (n=25) as compared with a control group (n=15).[9]

Another study found that patients with different anxiety disorders (PD with and without agoraphobia (n=33), social phobia (n=32), obsessive compulsive disorder (n=16), specific phobia (n=24) and generalized anxiety disorder (n=7) tended to remember fewer words in free recall and cued recall as compared with healthy controls (n=175).[13] These findings were validated by a study that showed poorer short-term memory for numbers and words in patients with PD (n=93) as compared with healthy subjects (n=36).[14]

Finally, one article compared patients with PD (n=24) and a control group (n=24). The authors found significant deficits in working memory and in the curved means of the results, both in encoding and recall, in different categories. However, PD patients had higher face recognition scores.[5]

Attention

Studies conducted in the 1980s divided attentional processes into two classes: parallel processes that work with unlimited capacity and processes that are more focal and selective and, therefore, work with limited capacity. This distinction also implies that the second type would only be required for more complex tasks.[23] Another important characterization of attention is the distinction between automatic and controlled processes. Automatic processes of attention do not require that the subject be focused or willing to perform an action. They are a type of involuntary reaction in the face of innate or previously learned stimuli. Additionally, these processes usually operate from associative connections. The controlled process requires focused attention and, therefore, has a limited capacity. This limitation is a benefit, because it allows better handling of the matter that is under focus.[24]

Controlled processes were the second most evaluated function, reported in eight articles. Five of these articles found no differences between patients with PD and a control group.[7,8,10-12] Of the three articles in which differences were found, two reported differences in selective attention.[5,14] In one article, patients with PD (n=24) showed more difficulty in completing a task that required visual attention as compared with a control group (n=24). According to the authors, this result demonstrates the difficulty in selecting relevant stimuli and is related to symptoms of the disorder, in which patients find it difficult to perceive their surroundings because their attention is focused on bodily sensations and concerns.[5] In another study, patients with PD (n=93) were compared with healthy controls (n=36) and showed decreases in selectivity, switching of attention and lower work capacity and stability of attention.[14]

The third article's results were contradictory to those of the previous two, because the patients evaluated showed no differences in selective attention tasks, although differences were found in divided attention tasks. The authors compared patients with PD with (n=16) and without agoraphobia (n=5), patients with PD and major depressive disorder (MDD) (n=21), and a control group (n=20). In selective attention tasks, the three groups performed similarly, but in divided attention, patients with PD were slightly faster than the patients with MDD and slower than the control group. However, the authors emphasize that these results may be related to use of the dual-task paradigm, which requires a higher attentional load that is not found in selective attention tasks.[15]

Executive function

The articles note that Luria was the first author to discuss executive functions. Although he did not use that term, he conceptualized a series of disorders associated with frontal lesions that generated problems of initiative, motivation, development of goals and action plans, and difficulties in self-monitoring. The term 'executive function' was first described by Lesak, who defined it as the skills required for effective behavior that is creative and socially acceptable.[4,25]

Importantly, this function has different components, which hinders the uniformity of findings. This definition

includes decision-making, inhibition of automatic responses, flexibility, and categorization.

Despite the difficulty of homogenizing the definitions of executive functions, one of the authors defines it as the process that links ideas, actions and simple movements to guide the resolution of more complex behaviors.[25]

In total, six studies performed tests that assessed this cognitive function. Of these articles, four found no differences in patients with PD when compared to the control group.[8-11] One of these articles found no differences when patients had only the diagnosis of PD (n=22); however, when patients had PD and MDD (n=11), they demonstrated greater latency in decision-making when compared to a control group (n=22).[10]

Of the two articles that found differences in executive functions, one noted that high levels of anxiety in patients with PD could affect cognitive functioning in more complex, generating strategies, such as category formation, which is typically required in executive function. These studies added that such difficulties are related to prefrontal areas and the medial amygdala, part of the neuroanatomical circuit of conditioned fear.[5] The other study used patients with PD with and without agoraphobia (n=33), social phobia (n=32), obsessive-compulsive disorder (n=16), specific phobia (n=24), generalized anxiety disorder (n=7) and a control group (n=175). To measure executive function, the authors used the Trail Making Test, forms A and B. In form A, there was no significant difference between the overall group of anxiety disorder patients, or any of its subgroups, and the control group. However, in the case of form B, the overall anxiety group needed more time to complete the form, as compared with the control group. This included the subgroup of PD patients.[13]

Psychomotor abilities and processing speed

Visuospatial and psychomotor skills play an important role in daily life, but as they are more automatic than other processes, their importance is perceived clearly only when there is a deficit. For example, when challenged by identification, discrimination, and analysis of a complex stimulus in visual processing, we resort to visuospatial and psychomotor skills.[26]

Six of the included studies evaluated psychomotor abilities or processing speed. Of these, four found no difference between PD patients and the control group.[7,10,12,13] One article compared groups of different anxiety disorders, such patients with PD with and without agoraphobia (n=33), social phobia (n=32), obsessive-compulsive disorder (n=16), specific phobia (n=24) and generalized anxiety disorder (n=7) to a control group (n=175); there was no difference between the groups.[13] Two articles[7,12] compared only patients with PD (n=69; n=14) to a control group (n=19; n=7) and found no differences. Another study[10] used three subgroups: patients with PD (n=22), patients with MDD (n=11) and a control group (n=22).

Among the articles that found differences, one detected lower visuospatial skills in PD patients. However, it is important to note that these data are only a reflection of differences in processing speed.[8] The other article found differences in time and distance traveled by patients with PD (n=31) to reach the target of a game played virtually when compared to controls (n=31). However, the authors noted that not all patients had this difficulty, and were able to subdivide the group of PD patients. While one group had such difficulties, the other group's result matched the results of the control group. To understand this difference, the authors noted that the group with difficulties was older and had a longer history of PD. Thus, they proposed that age and the course of the disorder could lead to a greater propensity for changes in cognition and a worsening of behavioral strategies.[16]

Verbal fluency

Only two articles[7,13] assessed this cognitive function, finding no significant differences. While one study compared patients with PD (n=69) to a control group (n=19),[7] the other compared different groups of anxiety disorders (patients with PD with and without agoraphobia [n=33], social phobia [n=32], obsessive-compulsive disorder [n=16], specific phobia [n=24] and generalized anxiety disorder [n=7]) to a control group (n=175).[13]

Affective processing of faces and words

Six articles were found that evaluated affective processing. Of these, three evaluated face recognition.[10,17,18] In one study, patients with PD (n=30) showed no bias for critical faces, but they did show bias for safe faces, a finding that is consistent with the trend of avoiding dangerous situations and seeking the presence of safe people, when compared to a control group (n=30).[17] This finding is confirmed by other studies. Patients with PD with or without agoraphobia (n=23) show greater vigilance toward fearful faces when compared to a control group (n=22).[18] Another study used happy or sad faces with three comparative groups: patients with PD (n=16), PD patients with MDD (n=21) and a control group (n=20). The results showed that the control group made more errors in blocks of sad faces, while the clinical patients made more errors in blocks of happy faces. This suggests that while the controls paid more attention to blocks of happy faces, the patients paid more attention to blocks of sad faces. However, the group with PD showed no differences between sad or happy face blocks. This finding indicates that negative attentional bias could be related to the presence of depressive symptoms.[10]

Another article showed a difference in the time taken to recognize panic-related words in patients with PD with or without agoraphobia (n=60) when compared to a control group (n=60).[19]

The other two articles used neutral words and words related to the disorder; in both studies, PD patients showed an attentional bias for information related to the disorder.[20,21] One of the studies compared patients with PD (n=15) to a control group (n=15),[20] and the other study compared patients with OCD (n=18), patients with

PD (n=15), patients with hypochondriasis (n=14) and a control group (n=19).[21]

Discussion

Although many studies have evaluated cognitive functions in psychiatric patients,[4] research into such functions in patients with PD is limited, as observed in this review. Other mental disorders seem to receive more attention in this area.[27,28] Still, a few studies have included neuropsychological testing. Many studies use only a few tests rather than a complete neuropsychological battery, which is necessary for a more comprehensive evaluation.

Studies about the neurobiology of anxiety disorders, particularly in the case of PD, are the foundation for establishing a neuropsychological profile of these patients. Advanced neuroimaging studies and their possible relationship to the effects of psychotherapeutic treatment[2,3] is also important, as neuroimaging studies provide a detailed picture of possible neuroanatomical substrates involved in PD and sites of specific activity, and can thus help increase treatment effectiveness.[3] Neuropsychological assessment, in turn, seeks to contribute to a more accurate diagnosis and prognosis and to improve our understanding of possible changes to cognitive functioning resulting from the disorder.[4] Thus, both modalities seek to develop of a clinical profile of these patients.

Neuropsychological assessment aims to map possible cognitive dysfunction from the results of tests, social and individual history and neuroimaging studies. Therefore, a neuropsychological diagnosis is generated from quantitative and qualitative aspects. The quantitative aspects refer to the values obtained in tests and compared to a normative population. The qualitative aspects relate to clinical history, which takes into account not only educational attainment and sociocultural level, but also the timing and history of the presenting complaint, possible impacts of symptoms in activities of daily living, interactions with friends, and professional life, history of family risk factors, medication use and even perceptions about how alert and cooperative the patient is during the evaluation.[4]

The theoretical foundations of neuropsychological assessment come from the interface of different sciences, such as medicine, physiology and psychology. In mental disorders, neuropsychological assessment can contribute to a clarification of the possible cognitive limitations related to a disorder and suggest better medical and psychotherapeutic interventions.[4]

An interest in the potential for cognitive impairment in obsessive-compulsive disorder, especially in memory and executive function,[27,28] is observed in the literature. Initially, the hypothesis was that such patients could have a deficit in remembering their actions, which might account for their compulsions. However, investigations suggest that this memory deficit is secondary; some even question its existence. A new hypothesis suggests that patients exhibit organizational difficulty in processing information or in performing executive functions.[27,28]

As do studies of patients with PD, studies of obsessive-compulsive disorder suggest that larger sample sizes and attempts at better control for comorbidities are necessary in future research. It is unclear whether the findings of these studies represent the specific profile of a disorder or whether they reflect patient anxiety and mood in general. It is important to analyze patient intellectual ability prior to testing to avoid such issues.[27,28]

Findings regarding PD are still inconsistent and divergent; this might be explained by methodological issues. Such issues might include the difficulty of locating a large number of patients without comorbidities in most studies, the challenges of determining the severity of the disorder at the time of evaluation and a lack of methodological standardization. Comorbidities that may be present in patients with PD generate doubt as to whether any deficits found occur only in this specific disorder.[5-7,10] Furthermore, the anxiety of the patient while performing tasks can bias results.

A survey of these results raised some questions. Would memory deficits be found only if they were a reflection of the patients' anxiety? Have these patients turned their attention to anxiety to the extent that it prevents them from concentrating on a given task? These questions make even more sense when an increased attentional bias is present, i.e., if the task involves emotional processing, such as in exposure to faces or words that are reminiscent of the disorder.[5,12,17-21]

Another question concerns the possible relationship between a decrease in processing speed and a change in executive functions. This question stems from one study, which hypothesized that differences in this area in one group of patients could be a result of the group itself being more prone to difficulty in behavioral strategies. These strategies relate directly to problem solving, planning, decision making, and impulse control, among other characteristics of executive functions.[8] Although most of the articles did not find changes in executive functions, it is necessary to expand upon these studies because change would be expected and would confirm all existing biological models of PD.[3]

Notably, four of the six studies that evaluated executive functions were written after 2004; this fact seems to demonstrate a recent and growing concern with the influence of executive functions in PD. This is because executive functions are known to be strongly related to the frontal region, and the neurobiological model of panic takes into account a subcortical hyperactivation and consequent cortical hypoactivation, especially in the frontal regions. Thus, changes in these two areas seem to be related.

In this review, only memory and affective processing showed more consistent differences in patients with PD, compared with control groups or groups of patients with other mental disorders. In the case of memory, scores were lower in these patients, but in the case of affective processing, their performance was higher when information related to the disorder was presented. These findings, especially with regard to affective processing, are consistent with the clinical features of PD, as patients with the disorder are biased to show special attention to all information, images or contexts that relate to PD or to the imminence of a new attack. This reinforces the

importance of psychoeducation and exposure, so as to desensitize patients and progressively enable the management of these feelings and distorted thoughts.

Nevertheless, further studies, with larger sample sizes and greater methodological standardization, are required. Furthermore, future studies should be aware of the different degrees of severity of the disorder in patients recruited and their symptomatology. It is noteworthy that studies on PD, the theoretical foundations of neuropsychology and standardized tests are recent. Therefore, the relationship between these factors is still poorly characterized. The interface between the fields of neuropsychology/neuroscience and psychiatric disorders aims to better understand these relationships and provide better primary interventions for patients.

Disclosure

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