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NEUROBIOLOGICAL ASPECTS OF ADHD
ATTENTION DEFICIT/HYPERACTIVITY DISORDER

*Aspectos neurobiológicos do transtorno do déficit de atenção e
hiperatividade (TDAH)*

Course Understanding the
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ABSTRACT

Individuals with adult attention deficit hyperactivity disorder (ADHD) have a deficit in their cognitive control. This study was based on field research with volunteers who shared their experiences with attention deficit disorder throughout their daily lives. All articles used in this study were obtained from Medline, Sciencedirect and Scielo databases. The present study has the objective of presenting a description of neuro-biological aspects of ADHD as well as TCC as a possible treatment and how ADHD interferes in everyday life.

INTRODUCTION

The causes of ADHD can be mainly genetic and environmental. About 25% of first-degree relatives of children with ADHD also have the disorder. In relation to environmental factors, some neurological damage or disease, high levels of lead, among other complications, can be highlighted.

Some authors believe that psychosocial factors may also be related to the onset and maintenance of the disease, especially family problems. ADHD usually manifests before 7 years of age. In 95% of them, the disorder appears before the age of 12. ADHD occurs in the child's developmental stage. It is estimated that ADHD reaches an average that varies between 3 to 5% of children, being more commonly found in boys than girls - boys are affected three times more than girls (Karande, 2005). In addition, teenagers and adults also live with this disorder.

ADHD SYMPTOMS

The main symptoms of attention deficit disorder include a - Frequent inattention in routine situations; Difficulty following instructions or completing a task; Having difficulties with activities that require reasoning or attention; Distraction due to external stimuli and lack of attention; Losing objects frequently; Restlessness in calm situations; Lack of patience waiting for the other to finish the activities and wanting to get ahead.

In childhood, the child demonstrates some of the characteristics such as agitation, excessiveness and impulsivity; In adolescence, they manifest difficulties in organizing their tasks. Agitation tends to decrease and so does concentration. They have low self-esteem and problems with containing impulses. (**Table 1**). After the age of 15, the youth is at risk of becoming more involved in fights and abusing alcohol and drugs; As adults, the person reaches this stage - without treatment - tends to demonstrate insubordination in the work environment, difficulty organizing

appointments, impulsivity and low self-esteem. (Couto, Taciana de Souza, de Melo-Junior, Mario Ribeiro, & de Araújo Gomes, Cláudia Roberta; 2010)

Phases	Features
Infant	Insatiable, irritable and difficult to comfort baby, with a higher prevalence of colic, feeding difficulties and sleep.
Preschool	Increased activity to the usual, adjustment difficulties, stubbornness, irritation and extremely difficult to satisfy.
Elementary school	Inability to focus, distracted, impulsive, unconscious performance, presence or absence of hyperactivity.
Teenager	Restless and with inconsistent performance, unable to focus, memory difficulties at school, substance abuse, accidents.

Table 1 - Classic clinical evolution of Attention deficit / hyperactivity disorder (According to Rohde et al, 2004).

The Diagnostic and Statistical Manual of Mental Disorders - DSM-IV (2002) - describes a set of symptoms for a diagnosis of ADHD and defines the age of onset of symptoms before the age of 7. The clinical presentation of ADHD comprises three groups of hyperactive ADHD symptoms; Inattentive ADHD and combined ADHD. In inattentive ADHD, marked characteristics of lack of attention and difficulty in sticking to details are presented, which cause marked errors in activities, whether they are school or not. It also has a lack of organization, which makes it more difficult to carry out its activities. Combined ADHD has symptoms of both subtypes (hyperactive and inattentive); people with attention deficit are easily distracted by the smallest stimulus, continuously interrupting their activities. Hyperactive-type ADHD manifests itself not only as motor restlessness, but also intellectual and verbal, also hindering its sociability. Impulsivity is evidenced by difficulties in self-control and self-regulation. (Rohde et al, 2004).

THE NEUROBIOLOGY OF ADHD

In the neurobiology of ADHD, theories propose the participation of systems related to inhibitory control and attention, the motivation or reward system, and the processing of emotions. Changes in cognitive systems would result in inattention and deficits in cognitive control, including executive dysfunctions. Therefore, changes in the processing of rewards would be related to the difficulty in anticipating a reward or waiting for a postponed reward, resulting in an excessive approach to potential rewards (reward anxiety) and impulsivity - hyperactivity. Changes in the processing of emotions, in turn, would be related to emotional dysregulation, which is common to ADHD.

The current scientific theory argues that in ADHD there is a dysfunction of dopaminergic neurotransmission in the frontal area (prefrontal, frontal motor, cingulate gyrus); subcortical regions (striatum, mediodorsal thalamus) and the cerebral limbic region (nucleus accumbens, amygdala and hippocampus). A change in these brain regions results in the patient's impulsivity (Rubia et al., 2001). In addition, the participation of noradrenergic systems in individuals with ADHD also occurs. The insufficiencies in the circuits of the prefrontal cortex and amygdala (**figure 1**), from the neurotransmission of catecholamines, result in the symptoms of forgetfulness, distraction, impulsivity and disorder (Armsten and Li, 2005).

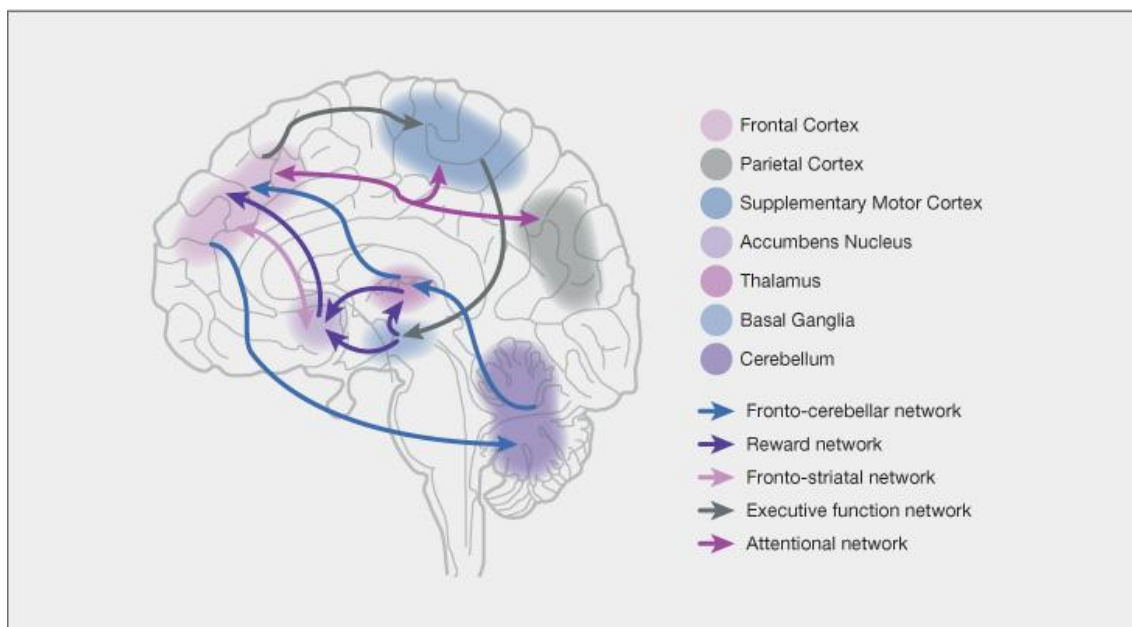


Figure 1 - Main brain areas affected in patients with attention deficit / hyperactivity disorders (ADHD).

The results of the neurobiological concept of ADHD are derived from neuropsychological studies, neuroimaging and neurotransmitters. In research studies using magnetic resonance images, decreased neuronal activity in the frontal region, anterior cingulate cortex and in the ganglia of the ADHD patient base (Bush et al., 1999). No change in a single neurotransmitter system can be responsible for a syndrome as heterogeneous as ADHD. The systems involved in ADHD neurobiology are related to each other, the combinations between cognitive and motivational or emotional processes are vital for regulating behavior in the face of different stimuli. (Couto, Taciana de Souza, de Melo-Junior, Mario Ribeiro, & de Araújo Gomes, Cláudia Roberta; 2010)

THE AMYGDALA AND ADHD

The amygdala is a subcortical region located in the medial temporal lobe. The amygdala is made up of nuclei that participate in distinct but interconnected processes. The basal and central nuclei receive inputs from the medial prefrontal cortex. The afferents of the central nucleus are related to innate emotional responses. The afferents of the basal nucleus are related to control of actions. The main function attributed to the amygdala is the conditioning of fear and the processing of negative emotions, in addition to being related to the processing of rewards (basolateral), reinforcement learning, memory and attention - cognition. The amygdala is also connected to regions of the autonomic nervous system and periaqueductal gray matter, which are involved with automatic responses and fear. Its schematic representation is shown in **Figure 2**.

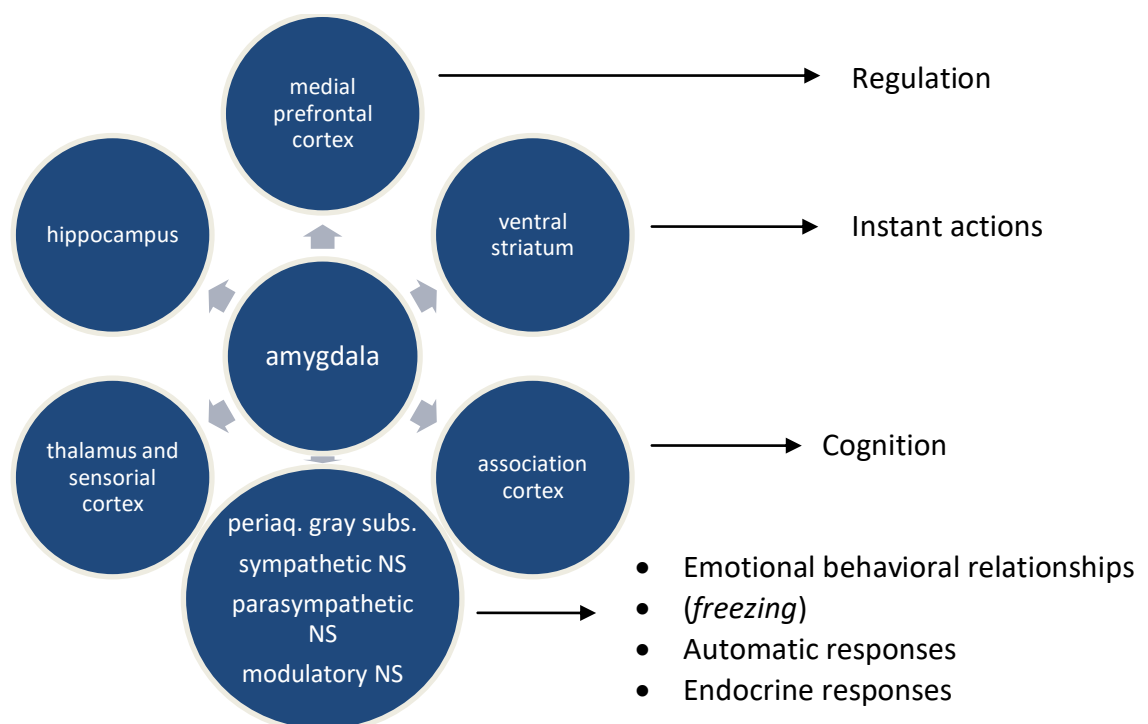


Figure 2 - Schematic representation of the amygdala connections (NS - nervous system; periaq. Gray subs. - periaqueductal gray substance).

Structural and functional neuroimaging studies indicate the involvement of the amygdala with the neurobiology of ADHD. Structural neuroimaging research found an association between ADHD and reduced amygdala volume. Changes in subcortical regions of children and adults with ADHD were evaluated and it was analyzed that the reduction of the amygdala was the alteration that had the most effect in these patients, thus seeing its importance in the emotional processes in this psychiatric disorder. ADHD has been shown to be associated with hyperactivation of the tonsil in emotional tasks - response to emotional stimuli, or emotionally neutral stimuli. Furthermore, as the amygdala is inextricably related to the processing of negative

emotions, under ADHD conditions, it supports the theory that ADHD would be averse to delaying rewards, indicates an altered processing of rewards. (Dias, Taciana Gontijo da Costa; 2017).

DIAGNOSTIC ASSESSMENT OF ADHD

The diagnosis of ADHD is clinical, although its signs can be detected early by the pediatrician who accompanies the child, it is of immense importance the patient's historical behavioral knowledge, based on the observation of parents and teachers. The diagnosis of ADHD is made according to criteria such as those in the Diagnostic and Statistical Manual of Mental Illness - DSM-IV-R and the International Statistical Classification of Diseases and Health-Related Problems - ICD 10.

Neurological assessment is of great importance, in order to exclude other possible diseases according to the symptoms that the patient may present. Two or more disorders may occur in the same individual (between ADHD and other psychiatric disorders), called learning disorders. According to DSM IV, they are reading disorders (dyslexia), math disorders (dyscalculia) and writing disorder (dysgraphia). In addition to the symptoms of the disorder, in many cases, the following also occur: Defiant opposition disorder (TOD) - defiant and oppositional behavior in relation to authority figures; Conduct disorder (CT) - a pattern of behavior in which the basic rights of others are disrespected (lies, theft, cruelty to animals, among others); Substance and alcohol abuse; Mood disorder - depression and bipolar disorder; Anxiety disorders, which are characterized by excessive fears or concerns that compromise academic, social and family life; And tic disorders - sudden vocal movements or sounds. (Couto, Taciana de Souza, de Melo-Junior, Mario Ribeiro, & de Araújo Gomes, Cláudia Roberta; 2010)

The diagnostic evaluation must be carried out every six months. It is recommended to observe the presence of six or more symptoms in the individual for the declaration of the diagnosis. The assessment for the diagnosis in ADHD must contain a history of all the symptoms narrated by the detailed patient, a comprehensive physical exam, an assessment of neurodevelopment and the performance of exams that aim to assess pedagogical performance. According to the DSM-IV criteria, symptoms are characterized in the three subtypes of ADHD (inattentive type, hyperactive type and combined type), the subtype classification is made according to what was observed in the individual in the last six months. Some studies show that there is a higher incidence of the combined subtype (about 80% of cases). This diagnosis also involves other complementary assessments with other medical specialties and other professionals - such as neurologist, psychiatrist, speech therapist and psychopedagogue.

COGNITIVE BEHAVIORAL THERAPY IN CHILDREN WITH ADHD (CBT)

CBT is an approach based on psychotherapy that understands the way each person sees, feels and thinks about a negative situation. This approach is very specific, clear and straightforward. It is used to treat various mental disorders efficiently. This form of psychotherapy emerged with the aim of bringing about behavioral and cognitive change - identifying patterns of behavior, thinking, beliefs and habits that are at the origin of the problems -, with the purpose that psychological disorders come from a distorted or dysfunctional model of perceive events influencing affection and behavior.

Some of the techniques of Cognitive Behavioral Therapy are: Reversal of habits to increase the patient's perception of each episode that brings discomfort; Increase awareness to identify the triggering factors and sequences of events associated with a particular symptom or behavior; Monitoring and recording of each occurrence; Use of an appropriate response to control the reaction; Stress control, teaching efficient ways of breathing, muscle relaxation and cognitive techniques; And relapse prevention.

Cognitive Behavioral Therapy (CBT) has stood out among the psychotherapeutic processes with positive results in individuals with ADHD, although CBT results seem less than the treatment obtained with medication (Pelham et al., 1993; Carlone cols., 1992). CBT is widely used in adults, but it has been showing its efficacy in the treatment of children and adolescents following the same theoretical assumptions of adult care - in cases of patients, children treatment has had a greater effect, reducing symptoms, for children from 8 years of age (Safren et al, 2005). Children with ADHD experience various criticisms and flawed actions that can lead to low self-esteem and insecurity. In this way, CBT has the objective of helping the patient to understand his abilities to improve his behavior and thinking, and also to develop self-control strategies.

ADHD-related CBT involves several aspects: education about ADHD for parents and those with the disorder; self-control skills; rule-controlled behavior; motivation in the face of results and problem solving strategies. But for these aspects to happen it is necessary for the therapist to know exactly the problems arising from ADHD and the patient's view of each and every type of situation. (Almeida, Juliana Vieira; Takase, Emílio; 2010)

FINAL CONSIDERATIONS

After conducting this research work on the neurobiological aspects of ADHD, I conclude that there is a wide range of information that can still be discovered, evaluated and considered for the scientific advancement of ADHD.

With this, I thank my colleagues - Natasha Vanzela, Caio Costa and Julya Rocha, psychology students at the University of Aveiro - who were available to help me, telling me about their experiences with Attention Deficit / Hyperactivity Disorder and showing me data and research.

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