Abstract

Attention deficit hyperactivity disorder (ADHD) is considered to be one of the most common neuro-developmental disorders in childhood, and is characterized by the following core symptoms: impulsivity, lack of attention, and behavioral motor symptoms. Over more than fifty years' of research in the field of ADHD, biological, cognitive and physiological theories have developed attempting to explain and even offer treatment for symptoms of the disorder. Despite decades of experience in diagnosing ADHD, and notwithstanding the technological advances that have occurred over the years, the diagnosis of ADHD has been conducted based on several behavioral criteria that are defined in the DSM-IV-TR book of psychiatry, and in the revised DSM-V edition. The diagnostic process of the disorder was based on several testimonies from different sources in accordance with the DSM criteria. None of the testimonies in itself can be used as sufficient evidence for the disorder. In addition, there is no single objective diagnostic tool that can determine the disorder but, instead, there is a battery of psychological diagnoses including: self-report questionnaires to the parent and child, didactic assessment and computerized tests. At the end of this process the final diagnosis is determined, based on past and present patterns of behavior, and refers to impairment in social functions. In the current study we present a combination of several theoretical models consolidated under the paradigm of Pre-Pulse Inhibition (PPI), that is tested using the Electromyography (EMG) technique, and may be effective in identifying the ADHD disorder, and early diagnosis of it. This technique is based on the PPI paradigm. PPI is a neurological phenomenon, in which the preliminary stimulation that presents prior to the target stimulus at a gap of 30-500 ms results in suppression of the patient's response to the target sound. In our study, the physiological responses of the patient were recorded using the EMG technique as a response to three different elements of the PPI paradigm:

1) Startle stimulus, also known as Pulse, is an auditory sound presented very intensely which causes the patient's reflexive response to a sudden strong stimulation. The physiological response that arises following the exposure of the patient to the pulse sound is called the Fear potential response and is explained by the Behavior Inhibition System (BIS). According to this theory, the central role of the BIS system is to produce physiological response adapted to perceptual stimulus.

2) Another element of the PPI paradigm is the sensorimotor gating mechanism by which filtration efficiency of the auditory information is examined. Sensorimotor gating is a physiological mechanism mediated by the central nervous system, allowing an individual to make a choice (unconscious) of whether to relate to the stimuli around him or to ignore them. This component is the foundation of the theoretical explanation of ADHD according to the top-down theory.

3) The rate of suppression of irrelevant information (percent of inhibition response) is the measure by which the filtration efficiency of auditory information is examined, in percentages. By means of the calculation formula the measurement allows for assessment of the levels of attention in subjects prior to and subsequent to medication therapy.

In light of this, there is considerable scientific importance to examining the PPI paradigm based on physical measurements to identify the symptoms of ADHD, and to control medication therapy in subjects with ADHD. In order to test the effectiveness of this

experimental tool for characterizing the symptoms of ADHD in adults - and to test the modification of physiological indices subsequent to use and medication therapy - a series of four experiments were designed.

The study involved 289 students, of which 126 men (65 men suffering from ADHD and 61 healthy men without ADHD and without learning disabilities) and 163 women (69 subjects with ADHD and 94 healthy women without ADHD and without learning disabilities). The objective of experiment 1 was to examine the use of a tool to characterize ADHD symptoms in a population of students with and without ADHD, using the EMG technique as response to the PPI paradigm. The second experiment examined bilateral differences among students with and without ADHD, by means of the EMG technique as response to a series of sounds, in accordance with the PPI paradigm.

The objective of the third experiment was to identify differences in the levels of activity of the central nervous system (CNS) in subjects with and without ADHD, and to examine the combination and the contribution of these peripheral measures to identifying symptoms of the disease. The fourth series of experiments includes clinical trials conducted in the Tirat Carmel hospital. The purpose of these experiments was twofold. The first objective was to intensify the results obtained in the first experiment, but under more controlled conditions. The subjects were diagnosed by DSM-IV-TR in a psychiatric hospital. They were divided into three groups according to the expression of behavioral symptoms belonging to the same group.

The second objective of the study was to examine changes in the physiological indices after medication therapy among people with ADHD. The study found a significant decrease in the physiological responses in the fear potential paradigm among subjects with ADHD, compared with subjects in the control group. Moreover, it was found that the fear potential measurement could be used as a physiologic effect through which it is possible to measure the success of medication therapy among subjects with ADHD. In addition, in clinical trials in which subjects with ADHD were divided into three groups according to the criteria in DSM-IV-TR, an obvious separation was found between all three groups of subjects with ADHD in the fear potential paradigm. A decrease in the level of attention was also found in all subjects with ADHD subjects, except for the hyperactive / impulsive group of subjects. We can conclude that the combination of measuring physiological responses using the EMG technique, together with the PPI paradigm, can be used to identify the symptoms of ADHD and provide a measure for evaluating the success of medication therapies.