

Hyperfunctional Voice Disorder in Children With Attention Deficit Hyperactivity Disorder (ADHD). A Phenotypic Characteristic?

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Summary: Objective. The purpose of this study was to detect specific vocal aerodynamic patterns in attention deficit hyperactivity disorder (ADHD) patients and to define a possible new phenotypic feature of this disorder that must be diagnosed and treated.

Study Design. This is a prospective study.

Methods. Seventy-nine children aged 5–13 years were recruited: 44 children with ADHD diagnosis and 35 children, as a control group, matched according to age and gender. All children were evaluated in the voice laboratory. Each subject repeated sustained vowels, syllables, words, and sentences several times. Intraoral pressure, transglottal airflow, microphone, and electroglottograph results were recorded and analyzed. Children affected by ADHD, with adequate tolerance, were evaluated endoscopically and by the speech therapist.

Results. The aerodynamic analysis shows that the subglottal pressure is higher and transglottal airflow is lower in ADHD children compared with the children of the control group. Those differences are statistically significant. The endoscopic physical examination showed vocal nodules in 25 children (78.125%) and hyperfunctional vocal behavior in all ADHD children studied.

Conclusions. We proposed that every child with ADHD disorder must be evaluated from a laryngeal point of view (otolaryngologist and speech therapist) as an important part of the diagnosis and global treatment. It could be considered as a new phenotypic characteristic of this disorder.

Key Words: ADHD–Subglottal pressure–Glottal resistance–Transglottal air flow–Vocal fold nodules–Hyperfunctional vocal behavior.

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is the most common neurobehavioral childhood pathology among child psychiatry and pediatric neurology consultations.¹ Along with dyslexia, it is the leading cause of school failure and conduct disorder in childhood.²

It is estimated that this disease affects 5–10% of school-age children^{3,4} and 3–5% of patients in the adulthood,⁵ according to the diagnostic criteria used. The scientific bibliography consulted agrees that this pathology is more frequent in men than in women, encrypting up to four: one the boy-girl relationship.⁶

The social, economic, academic, and family impact is very important, even affecting the quality of life of the subject. The annual cost per child with a diagnosis of ADHD in the United States is between \$12 005 and \$17 458.⁷

The main symptoms that characterize ADHD are hyperactivity, impulsivity, and inattention. Restlessness and talkativeness are some of the characteristics of impulsivity and hyperactivity symptoms. Lack of concentration, children apparently daydreaming or difficulty sustaining attention on a single task for an extended period, should be suggestive of symptoms of inattention.

The exact cause of ADHD is unknown.^{1,5,8} It is believed to be a multifactorial disease with a neurobiologic basis and genetic predisposition that interacts with environmental factors.⁹

ADHD could be defined as a disorder of self-regulation behavior, which would point toward the existence of a dysfunction of the frontal-subcortical system.^{10–12} Dopamine is a neurotransmitter playing a key role in the prefrontal cortex and is responsible for inhibiting or modulating neuronal activity involved in emotions and movement. Noradrenaline or norepinephrine acts at the posterior parietal cortex, and its function is related to the ability to maintain a state of alertness and attention. Therefore, neurotransmission function alterations in dopamine and noradrenaline are, in part, responsible for the appearance of the characteristic symptoms of this disease.

A diagnosis of attention deficit disorder and hyperactivity disorder is a clinical diagnosis. There are two classification systems for psychiatric disorders: the ICD-10 (International Classification of Mental Diseases at OMS, 1992) and DSM-V (Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association, 2013). The DSM-V classification system lists five criteria (A–E) that have to be present to establish a diagnosis of ADHD. This classification distinguishes between the three forms of presentation, according to the A criterion, which must be specified for each patient: the combined presentation (50–70%) if A1 criterion (inattention) and A2 criterion (hyperactivity-impulsivity) are observed over the last 6 months, the predominant inattention presentation (20–30%) if just A1 criterion (inattention) is observed for the last 6 months, and the predominant hyperactive/impulsive presentation (10–15%) if A2 criterion (hyperactivity-impulsivity) is maintained for the last 6 months.

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TABLE 1.**Comparison of the Results of Aerodynamic Study of Voice Between Children With ADHD Diagnosis and Healthy Children**

Aerodynamic Parameters	ADHD Group \bar{x} (95% IC)	Control Group \bar{x} (95% IC)	P Value
Subglottal pressure (mm H ₂ O)	117.18 (110.41–123.95)	101.38 (93.60–109.16)	0.003
Transglottal airflow (L/s)	0.11 (0.061–0.170)	0.21 (0.139–0.289)	0.038
Laryngeal resistance (mm H ₂ O)	3465.82 (1602–5330)	1336.41 (1053–3785.7)	0.173

The ICD-10 calls ADHD hyperkinetic disorder. To establish the diagnosis of ADHD according to this classification, the patient must show six symptoms of inattention, three hyperactivity symptoms, and one symptom of impulsivity in more than one environment of the child's life. This ranking, unlike the DSM-V, does not make a difference between the forms of presentation, and necessarily requires the existence of the three types of symptoms to establish diagnosis.

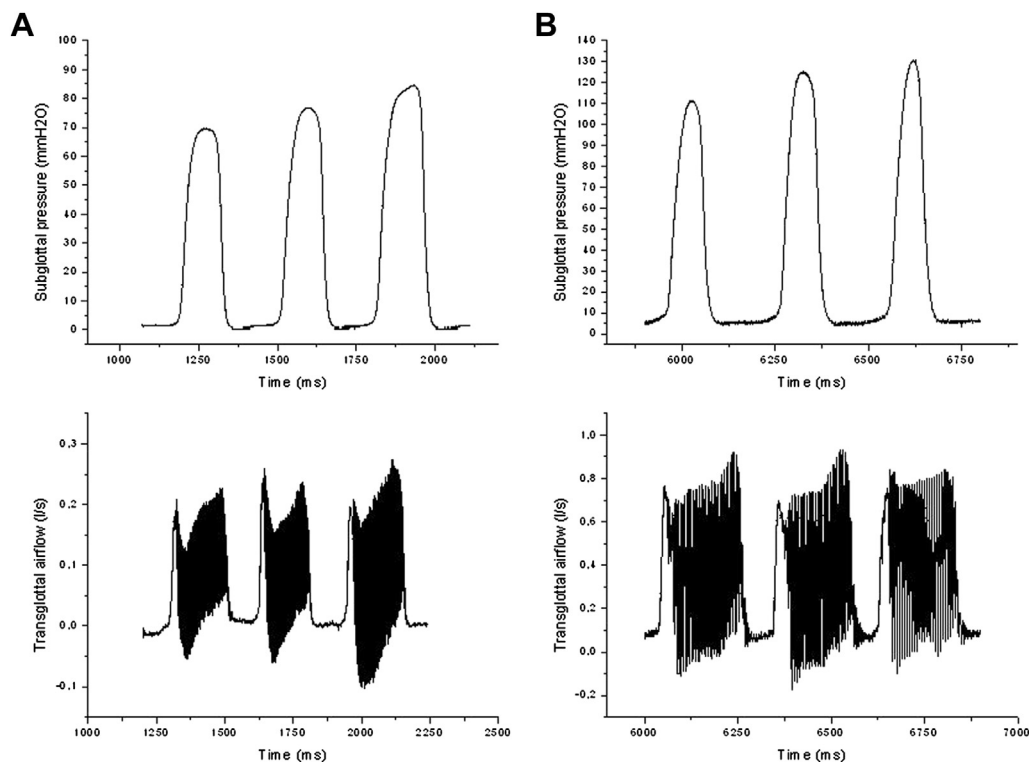
The ADHD treatment is based on the combination of specific pharmacologic treatment and child behavior therapy, in which parents and teachers play a vital role. Stimulants, nonstimulants, and tricyclic antidepressant drugs are those currently used for the treatment of this disorder. Nonpharmacological interventions have been included as an essential and necessary part for the treatment of patients with ADHD. Among the nonpharmacological interventions, we must differentiate between psychological interventions that include behavior therapy, parent training, and social skills training and psychoeducational interventions involving different practices to enhance learning in the school context.¹³

"Talking too much" is one of the symptoms included in DSM-V as hyperactivity/impulsivity criterion. This impulsive and talkative nature could be a risk factor for the abuse and

misuse of the voice and the onset of functional dysphonia with or without associated morphologic lesions. The purpose of this study was to detect specific vocal aerodynamic patterns in ADHD patients and to define a possible new phenotypic feature of this disorder that must be diagnosed and treated to prevent organic lesions and sequelae in phonation organs (vocal folds) as a result of repeated trauma.

MATERIALS, SUBJECTS, AND METHODS**Subjects**

The study included a sample of 79 children divided into two groups. The first group consisted of 44 children diagnosed with ADHD: 39 boys and five girls aged 5–13 years. The diagnosis of ADHD was established through a clinical interview, following the criteria of DSM-IV classification. We include, in our study, every patient diagnosed with ADHD in our hospital between February 2012 and October 2012. In the control group, 35 children with no history of ADHD and lower scores than the children with ADHD diagnosis, according to the results of the DePaul questionnaire, were included. Both groups studied had similar age range and gender distribution.

**FIGURE 1.** An example of subglottal pressure and transglottal airflow. (A) Control group child. (B) ADHD child.

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