Vocal Fold Nodules in School Age Children: Attention Deficit Hyperactivity Disorder as a Potential Risk Factor

Lucia D'Alatri, Livia Petrelli, Lea Calò, Pasqualina Maria Picciotti, Maria Raffaella Marchese, and Francesco Bussu,
Rome, Italy

Summary: Objective. To evaluate the presence of symptoms of inattention and hyperactivity/impulsivity in a population of school age children affected by vocal fold nodules.
Methods. Parents and teachers of 18 children with vocal fold nodules (10 males, eight females; aged between 6 and 12 years) and 20 matched controls without dysphonia and/or vocal fold diseases (11 males, nine females; aged between 6 and 12 years) completed Attention-Deficit/Hyperactivity Disorder (ADHD) rating scale for parents (SDAG [Scala per i Disturbi di Attenzione/Iperattività per Genitori]) and teachers (SDAI [Scala per i Disturbi di Attenzione/Iperattività per Insegnanti) rating scales containing in two subscales items that specifically evaluate the symptoms of ADHD according to the DSM-IV. All children were subjected to videolaryngoscopy.
Results. The group with vocal fold nodules scored significantly higher than the controls; the difference between the two groups was statistically significant for both the subscales of both questionnaires (SDAG and SDAI) ($P < 0.05$). Four children in the group with vocal fold nodules who scored higher than 14 in at least one subscale were referred for psychiatric evaluation. For two of the children, both male, a diagnosis of combined ADHD was formulated.
Conclusions. ADHD is a possible risk factor for the development of vocal fold nodules in childhood. SDAG and SDAI rating scales may supplement the diagnostic assessment of children with vocal fold nodules.
Key Words: Vocal fold nodules–Childhood dysphonia–Attention deficit hyperactivity disorder–ADHD.

INTRODUCTION

Studies on the epidemiology of dysphonia in school age children describe a prevalence that ranges widely from six to 38%,[1–4] reflecting differences in survey methods and in the criteria used for voice evaluation. Most authors, however, estimate a prevalence of 6–9%.[4]

Vocal fold nodules represent the most common laryngeal cause of voice disorders in children[4,5]; between 38% and 78% of children evaluated for chronic hoarseness are estimated to have vocal fold nodules.[6] Nodules are characterized by bilateral thickening at the junction of the anterior and middle thirds of the vocal folds. Histological analyses of vocal fold nodules have revealed proliferation of the epithelial layers, thickening of the basal membrane and the presence of fibronectin in the superficial layer of the lamina propria.[7]

Vocal fold nodules are associated with chronic vocal abuse or misuse.[8,9] Vocal abuse can be described as yelling, talking in excess, singing, laughing, crying, cheering, imitating animal noises, and making sound effects. The quality of communicative interactions in the family, the child's personality, and the way he/she asserts him/herself may be other determinants of hyperfunctional vocal behavior. Moreover, effort and mechanical traumatism in phonation may be exacerbated by different factors such as recurrent infections of the upper airways, allergies, gastroesophageal reflux, hearing impairment, velopharyngeal insufficiency, and pollution from environmental noise. In addition, the characteristics of a child's larynx (ie, immaturity of intrinsic muscles and incomplete development of the vocal ligament) make it more vulnerable to phonotrauma.[10]

Literature data about pediatric hyperfunctional dysphonia indicate a predominance of males (57–64%) over females (36–43%) with a ratio close to 2:1.[8,9,11] These findings could be related to the impulsive and aggressive behavior often associated with hyperactivity, anxiety, and spirit of leadership among boys.[12]

Voice therapy is part of the recommended therapeutic strategy for vocal fold nodules in children.[13–15] Vocal hygiene, including the avoidance of voice abuse, is another relevant component of treatment. Involvement of parents and teachers is important in treatment planning. However, the psychological traits of dysphonic children are likely to make them noncompliant to active voice therapy and vocal hygiene recommendations.[16,17]

Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disorders in children and adolescents.[18–20] A recent systematic review showed that in 2010, the ADHD worldwide pooled prevalence for the age range 5–19 years was 2.2% (2.0–2.3) and 0.7% (0.6–0.7) for males and females, respectively.[21] ADHD is characterized by either significant inattention, hyperactivity, impulsiveness, or a combination of these traits.[18–20,22] According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR),[22] ADHD symptoms emerge before 7 years of age, must manifest in at least two separate settings and must result in an impairment in one or more functional domains. Inattention is characterized by difficulties in remaining focused, poor attention to detail, inability to work on the same task for an extended period

Accepted for publication July 30, 2014.
From the ENT and Ophthalmology Department, Institute of Otorhinolaryngology, Policlinico "A. Gemelli", Catholic University of Sacred Heart, Rome, Italy.
Address correspondence and reprint requests to Livia Petrelli, Policlinico "A. Gemelli", Università Cattolica del Sacro Cuore, Largo Gemelli n.8, Rome 00168, Italy. E-mail: livia83@hotmail.it
Journal of Voice, Vol. 29, No. 3, pp. 287-291
0892-1997/$36.00

http://dx.doi.org/10.1016/j.jvoice.2014.07.019

of time, difficulty in performing actions, rapid onset of fatigue, and boredom.[18–20,22] Hyperactivity is characterized by constant and excessive motor activity and the inability to respect the rules, time, and space of others.[18–20,22] Impulsivity, often linked to hyperactivity, manifests as a difficulty in avoiding dangerous situations, a tendency to move quickly from one activity to another and a tendency to talk too much with poor control of vocal intensity.[18–20,22]

Although the finding that children with vocal fold nodules are impulsive and aggressive is quite common among clinicians,[9,23,24] there are few objective data to reject or promote the hypothesis that a behavioral disorder may underlie the development of vocal fold nodules in children. Although the association between vocal fold nodules and personality traits, such as elevated social dominance, emotional reactivity, aggressiveness and impulsivity, has been described in women,[25,26] the relationship between specific personality traits and the development of vocal fold nodules still needs to be confirmed in children.[27]

In this study, using parents' and teachers' rating scales, we investigated the presence of symptoms of inattention and hyperactivity/impulsivity in a population of school age children affected by vocal fold nodules and in a vocally healthy control group.

METHODS

The research described in the following was reviewed and approved by the Local Review Board at the Catholic University of the Sacred Heart and was conducted according to the principles expressed in the Declaration of Helsinki. Permission was obtained from the school authorities and parents or guardians of the children.

During a period of 6 months, 32 children (18 males, 14 females; mean age 6.72 ± 4.22 years) affected by dysphonia were referred to our speech and language disorders unit. All patients underwent the following:

- Collection of clinical history, to specifically analyze speech and language development, and the behavioral characteristics and vocal attitudes of the child and his/her family;
- ENT examination of the upper airways including flexible fiberoptic videolaryngoscopy without stroboscopy (model RLS 9100B; Kay Elemetrics Corp., Lincoln Park, NJ);
- A perceptual evaluation, performed on recorded voice samples by a panel of three speech therapists with a minimum of 3 years of clinical experience in children's voice therapy, using the GRBAS (Grade, Roughness, Breathiness, Asthenicity, Strain) scale[28];
- Audiological evaluation.

Eighteen of the 32 children (10 males, eight females) were included in the study and were designated as group A. The inclusion criteria for the recruitment of children into group A were as follows: age between 6 and 12 years; bilateral vocal fold nodules; history of dysphonia for at least 12 months; no previous voice therapy; normal hearing, as measured through behavioral sound field audiometry and defined as an auditory threshold $\leq$ 20 dB nHL at all tested frequencies (250–4000 Hz); no history of recurrent inflammation of the upper airway, allergies, and gastroesophageal reflux; and the absence of bronchopulmonary diseases.

The control group, group B, was composed of 20 children (11 males, nine females) randomly selected from all of the children who periodically came to the hospital's pediatrics department for wellness visits. The inclusion criteria of these children were the same as for children in group A without, of course, any report of dysphonia or vocal fold nodules. Moreover, before inclusion as a control subject, the child's voice had to be judged as normal by three speech therapists. Specifically, the control subjects had to be classified by a 0 score in all of the GRBAS items by all of the speech therapists.

After obtaining informed consent from the parents, two screening questionnaires addressing DSM IV criteria for ADHD, SDAG (Scala per i Disturbi di Attenzione/Iperattività per Genitori [ADHD rating scale for Parents]) and SDAI (Scala per i Disturbi di Attenzione/Iperattività per Insegnanti [ADHD rating scale for Teachers])[29] (Figure 1), were completed by the parents and teachers of the children in both groups. The two scales, validated and standardized for the Italian population, are similar in organization and scope to those widely used in other countries.[30] Both tools contained 18 items that closely mirror the DSM-IV ADHD symptoms.[31] In each scale, nine items (marked with odd numbers) explore Inattention (subscale In), and nine items (marked with even numbers) explore Hyperactivity/Impulsivity (subscale H/I). Frequency and intensity of the 18 ADHD symptoms are rated on a 4-point Likert scale from 0 to 3 (0, never, 1, sometimes, 2, often, 3, very often). Therefore the overall scores for subscale In and subscale H/I of the SDAG and SDAI rating scales may vary from 0 to 27. The cut-off for considering a child for a possible diagnosis of ADHD and for referring him/her to a psychiatrist is represented by a score above 14 in at least one subscale. In the patient group, we looked for correlations between GRBAS scores and scores from the four subscales.

Statistical analysis

For comparisons between groups, the Student *t* test for unpaired samples was used. Correlation between numerical variables (GRBAS and SDAI/SDAG scores) was evaluated by linear bivariate fit and analysis of variance. The level of significance was set at $P < 0.05$. The statistical package *MedCalc* (MedCalc Software bvba, Marienkerke, Belgium) was used.

RESULTS

The two groups did not differ significantly in age (mean age of group A = 8.83 ± 2.15 years; mean age of group B = 8.45 ± 1.57 years; $P > 0.05$) or gender ($P > 0.05$).

The comparison between groups showed that the mean scores of group A were higher for subscales In and H/I of the