

LITERATURE REVIEW

Dysphonia in children

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ABSTRACT

Dysphonia is a frequent symptom in paediatric patients and it has a prevalence between 6 - 24%. In young patients, dysphonia has a direct importance because it impairs their communicative behaviour, their psychological status and also their social life.

The most diagnosed voice pathologies in children are vocal nodules followed by vocal cord cysts, infectious and inflammatory causes, sulcus vocalis, laryngeal membranes, iatrogenic vocal cord paralysis, neurological causes, psychogenic factors, traumatic or irritative factors or, less commonly, laryngeal neoplasms.

A correct diagnosis of dysphonia in paediatric patients is important for learning, voice training and their psychological development. Children with dysphonia have to be assessed with adequate equipment. It is recommended to use tools that are appropriate to the tolerance and cooperation of the patients and allow to have a good visualization of the vocal folds. Suitable preventive methods, early diagnosis, appropriate treatment of voice disorders should be taken into consideration in these cases.

In this article, some of the most frequent causes of dysphonia in paediatric patients and their treatment options in order to achieve a proper voice are reviewed.

KEYWORDS: dysphonia, paediatric patients, vocal nodules, mutational dysphonia, voice therapy, laryngeal papillomatosis.

INTRODUCTION

Dysphonia in children include a large spectrum of diseases varying from a slight hoarseness to the incapacity to speak and it is associated with an inappropriate pitch, loudness, vocal effort, which alter the voice quality. The prevalence of paediatric dysphonia in the international literature varies between 6 to 24%, in some cases even well above that¹⁻³.

Children's voice is principally fragile, and childhood vocal abuse may have consequences lasting through their life. It is very important for the voice of the child with artistic inclinations to acquire a correct vocal technique and to avoid vocal abuse. In young patients, dysphonia has a direct importance, affecting their psychological states and their communicative behaviour. These may induce a more negative judgment by other children, adolescents or adults.

The conditions and experiences achieved for adults regarding the voice diagnostic cannot be applied directly to the adolescents and children, because the dynamic development and, consequently, the normative value spectrum should be taken into consideration.

It was observed that in 40-80% of children changes in voice have emotional response such as sadness, frustration, anger and decrease social contacts, diminishing vocal contribution during recreational activities and also during classes⁴.

There have been described some risk factors for children dysphonia such as: attention deficit hyperactivity disorders (ADHD), older siblings, male gender, spending time in large groups. Anatomically, the cartilaginous section of the vocal folds expands relatively less with age; therefore, the proportion of membranous-to-cartilaginous vocal cord is 1.5:1.0 in the newborns, 5.5:1.0 in the adult males and 4.0:1.0 in the adult fe-

males¹. In the immature vocal folds, the absence of protective three-layered structure in the vocal ligament makes children more predisposed to tissue reactions as a consequence of the voice abuse³.

The most commonly diagnosed voice pathologies in paediatric patients are vocal nodules (50% - 70%), followed by vocal cord cysts, infectious and inflammatory causes, sulcus vocalis, laryngeal membranes, iatrogenic vocal cord paralysis (secondary to head and neck or cardiothoracic surgery), neurological causes, psychogenic factors, traumatic or irritative factors or, less commonly, laryngeal neoplasms among others⁵⁻⁷.

A correct diagnosis of dysphonia in paediatric patients is essential for learning, voice training and their psychological development. A general otorhinolaryngologic examination should be performed, involving examination of the ears and also hearing. The assessment of the voice should be detailed and can use a combination of objective and subjective voice analysis measures, consisting of perceptual evaluation of voice, flexible nasal endoscopy or videostroboscopic imaging of vocal cord movement or microlaryngoscopy, acoustic and aerodynamic analysis^{6,8}. Self-assessment tools are also important and may contribute with additional information useful for screening. Children and their parents visiting the voice clinic are asked to perform the paediatric voice handicap index and the paediatric voice-related quality of life questionnaire.

With reference to the laryngeal examination in children, it is suggested to use tools that are appropriate to the tolerance and cooperation of the patients and allow to have a good visualization of the vocal folds. Flexible nasopharyngolaryngoscopy can be performed on a child at almost any age. It can be done with the patient awake and without requiring significant cooperation. It is suited to identify most laryngeal lesions, bringing images with a good quality and it can be associated with stroboscopic light⁸.

Rigid videolaryngoscopy is an instrument that can be used for laryngeal assessment in children with dysphonia, allowing a good visualization of the entire larynx. This examination is performed with the patient awake and it needs a higher level of cooperation, therefore it is performed in children older than 7 years. In children younger than 7 years old, it is difficult to assess vocal fold vibration because they have a shorter phonatory time and greater pharyngeal reflex⁹. Rigid videolaryngoscopy is fundamental in discovering small structural injury in the laryngeal mucosa. It is important to distinguish between vocal nodules and vocal cord cyst with reactive lesion, by evaluating the vibration of the vocal cords. The right diagnosis is essential for choosing the most favourable treatment^{8,9}.

Microlaryngoscopy under general anaesthesia allows a great visualization of the structural lesions of the larynx, but without information about the dynamic function.

This examination is used in poorly compliant patients. It has the advantage that a laryngeal lesion may be biopsied or excised¹.

VOCAL PATHOLOGY IN CHILDREN

Vocal nodules

Vocal nodules are the most frequent cause of dysphonia in children, being described in more than a half of these patients. The most affected children are those with siblings, attention deficit hyperactivity disorders (ADHD), the male gender being more predisposed to this pathology than girls. A peak of age is considered to be between 5 and 10 years¹⁰. Vocal abuse produced by sports is observed frequently in boys^{10,11}.

Children with attention deficit hyperactivity disorder have a behaviour which is more impulsive; they are more talkative, having a tendency to talk over others. These characteristics lead to yelling, tantrums, screaming and, in consequence, they have an increased risk of phonotrauma¹⁰⁻¹³.

Children who sing from a very young age are more likely to develop dysphonia. Usually, they do not have an appropriate technique, most of them do not have canto lessons. Laryngopharyngeal reflux and allergic laryngitis are risk factors for the appearance of vocal nodules, because laryngeal edema necessitates increased effort and subglottic pressure for phonation. Dehydration is another risk factor that can lead to vocal nodule development. This may be as a result of poor water intake or nasal obstruction that can lead to less humidification of the air and nasal secretions which affects the laryngeal mucosa¹⁰. The severity of the hoarse voice has been demonstrated to be correlated with nodule size.

The treatment options of vocal nodules include vocal hygiene and behavioural changes, directed voice therapy, treatment of correlated factors (allergy, cough, reflux) and rarely surgical intervention. Firstly, the therapeutic approaches focus on teaching the patients and their family to concentrate on new and adequate vocal behaviours and on differences between the new technique and previous voice behaviour that conducted to vocal nodules.

Indirect voice therapy, such as vocal hygiene, makes subtle and efficient changes in the patient everyday routine. This approach focuses on decreasing the caffeine and acid intake; increasing water and humidifying dried air can be helpful in improving the overall symptoms.

Intervention approaches are variable and depend on the patient stimulability and it is commonly correlated with age. Patients of 5-6 years old can usually start to receive therapy that focuses on eliminating or changing behaviours. Patients of 6-10 years old who are diagnosed with vocal nodules and receive therapeutic interventions show a good voice-related outcome. These intervention methods are focused on self-monitoring, discussing the diagno-

sis, homework tasks, independent recognition of vocal hygiene, direct clinical feedback and vocal exercises targeting the intrinsic tension¹⁴.

Changing the environment of the larynx may be useful in adjusting the effects of edema on voice use, which may make the nodules more symptomatic. Throat clearing and phonotrauma associated with chronic cough may be decreased by the modification of laryngopharyngeal reflux and allergy. Beside the hydration from the diet change, there are some medications that may be recommended to these patients such as antihistamines, nasal saline, nasal corticosteroids and antacid therapy^{10,13,14}.

Surgical interventions are reserved for patients who have not had any improvement with voice therapy and who have a severe perception of their voice. Before surgical intervention, a minimum 12 months of voice therapy with good compliance to these therapies is recommended, but with minimal perceptual improvement¹⁴.

Laryngeal cysts

Laryngeal cysts represent the second cause of dysphonia in paediatric patients and can be epidermal and mucosal cysts. The epidermal cyst may be a consequence of remaining epithelium captured within the lamina propria or may develop after vocal abuse. The epidermic cyst has caseous content, pearl-like aspect and it is located on the subepithelial layers of the vocal cords. The mucosal cyst is secondary to the blockage of the glandular ducts. This condition appears after laryngitis because of gastroesophageal reflux and after voice overuse. Usually, a vocal cyst is localized in the vocal region but may also be present in the vestibular region of the larynx and the subglottal region¹⁵. Most of the patients present with stridor, dysphonia and signs of upper airway obstruction. The therapeutic approach is microsurgery including coagulatory ablation, laser marsupialization, decortication which is performed with cold microinstruments followed by laser approach to the cyst bed. Surgical treatment of the vocal cyst is based on minimal manipulation of the surrounding tissues to avoid fibrotic injuries¹⁶.

Laryngeal papillomatosis

Laryngeal papillomatosis is a pathology that must be diagnosed; if the initial symptom is voice disturbance, it may then progress to upper airway obstruction. This pathology is caused by human papilloma viruses (HPVs), usually types 6 and 11. In paediatric patients, the transmission is maternofetal, and it is associated with the passage by the birth canal, though it was observed that the birth through caesarean method is not entirely protective. This indicates that there is a more complex way of transmission in mother's utero¹⁷.

Nowadays, there is no curative treatment for this pathology. The therapeutic approach of laryngeal papillomatosis aims to improve breathing and voice by surgery and adjunctive medical treatment. The surgery targets to re-

move the bulky tumor, to avoid the damages and scars of the adjacent laryngeal structures to preserve the voice outcome. Regarding the adjuvant medical treatment, cidofovir, valaciclovir, interferon, indole-3-carbinol or photodynamic therapy can be used^{18,19}. Quadrivalent HPV vaccination (Gardasil®) has been introduced recently in current practice²⁰. These therapies are reserved for patients who need frequent surgery procedures, having as a goal to diminish the number of surgeries required and to improve the voice^{18,19}. The voice therapy is recommended postoperatively in order to avoid the formation of scars and to obtain a flexibility of the tissues.

Vocal fold paralysis

Vocal fold paralysis in paediatric patients has varied causes, such as congenital, iatrogenic, traumatic or neurological causes. Usually, patients with unilateral vocal fold paralysis present with voice disturbance, weak voice and cry, feeding difficulties, aspiration with feeding or even stridor. In these patients, it is uncommon to have the airway considerably compromised. Over time, there may be observed an improvement in symptoms, which may be due to the compensation of the contralateral vocal cord or a spontaneous recovery of the laryngeal function²¹. There are a few cases that have persistent dysphonia over time and, for these patients, the medialization thyroplasty technique can be performed. In the prepubertal period, there are some concerns about the possibility of the silastic implant to interfere with the physiological growth spurt and, after this period, the position of the implant may change. In this category of patients, there is a less invasive procedure that is preferred, such as vocal fold injection^{1,21}.

Bilateral vocal fold paralysis represents almost 60% of cases of vocal fold paralysis in children²². In these cases, the main problems are due to airway obstruction, respiratory distress and, less severe, the voice affects the child because a strong voice and cry are maintained²³. Despite the fact that in unilateral vocal fold paralysis the management is focused on closing the glottis, in bilateral vocal fold paralysis the management is aimed at improving the airway. Traditionally, tracheostomy was performed in these cases, but nowadays this procedure is less commonly used because it was observed that there is a chance for spontaneous resolution. Therefore, lately, procedures for static glottic opening have started to increase in paediatric patients, such as arytenoidopexy, arytenoidectomy, cartilage grafting, or posterior cricoid split with or without balloon expansion^{23,24}. All these techniques improve breathing but, secondary to the static opening of the glottic space, there will be the risk of affecting the voice quality and the ability to protect the airways. In those congenital cases, a spontaneous recovery can occur, but if after at least 2 years of waiting there is no sign of recovery, it is less likely to happen after this period. Patients who have a neuro-

logical cause for the bilateral vocal fold paralysis have a probability of regaining the dynamic laryngeal function by restoring the neural input in bilateral selective laryngeal reinnervation. This procedure is considered to be useful and safe in treating paediatric patients with bilateral vocal fold paralysis at the age of 2 years. An early reinnervation is advantageous, allowing the child to be extubated and to improve voice and speech before starting to go to school^{24,25}.

Mutational dysphonia

Mutational dysphonia, also called puberphonia, is described as a failure of the natural decline in pitch or fundamental frequency. This pathology has an important impact on the patient's life with numerous consequences on the quality of life and personality of the child. Usually, they confront with emotional, psychological, professional and social problems. Mutational dysphonia commonly manifests at 12 years old, later during the puberty. It was observed that there are some differences between boys and girls regarding the period of manifestation. During puberty, the rapid change in the larynx is more obvious in boys, who develop mutational dysphonia between the age of 11 and 13 years. The period of manifestation in girls is between the age of 12 and 14 years^{26,27}.

In this process of mutation, the boy's voice gets lower on the average with one octave and the girl's voice with two to three tones associated with parallel modification of the vocal range. Clinically, laryngological modifications occasionally suggest an inflammation of the larynx. A mutational triangle representing posterior glottic phonatory insufficiency may be observed. In a boy's voice, an adaptive paradox in vocal modification may appear, and he must be guided through this new circumstance with specific exercises. In the psychological paradox of vocal modification, the patient denies recognizing himself as an adult and needs to engage in cooperative work with a psychotherapist. Boys with a gender-presenting attitude who look for feminization or voice modification require synergic work with a speech therapist and a psychotherapist. During the therapy, the patients and their parents should be influenced to agree with the breathy voice until the voice changes are accomplished. Regarding the therapy, the patient should begin with exercises which increase the balance and elasticity of the phonatory muscles^{28,29}.

There are some controversies regarding the perfect time to start vocal training or singing. The most supported idea is to start serious singing and vocal training after puberty and voice stabilization in boys and just before puberty in girls. However, if the child has potential and vocal inclination, it is reasonable to begin specialized vocal training during childhood. Initially, the child has to be taught to avoid all types of vocal abuse and to vocalize without effort. Some authors recommend that, particularly in boys, singing should be avoided or minimized through puberty²⁹.

VOICE THERAPY IN DYSPHONIC CHILDREN

There are some particularities that should be taken into account in children's voice reeducation in comparison with adult's voice reeducation. The reeducation method has to be adjusted for the child's level of understanding and the age, and it should be designed as a game to keep up the child's attention³⁰. There might be two distinct situations when the singing voice of a child is inappropriate: a difficulty of singing in the proper way, without any vocal disorder, and chronic dysphonia that is evident only in the singing voice, which is usually not noticed by the parents³¹.

Stories and pictures should be used to help children with vocal abuse become aware of its impact on their voice. After the vocal abuse is detected, it is important to discuss the possibility of reducing its frequency. The patients can remark their daily circumstances of vocal abuse on some graphs, which can be discussed in the therapy session. In children with benign vocal cord lesions, the voice therapy is the first treatment option. During this therapy, it is essential to stimulate the child to practice his new voice outside the voice therapy sessions. In these circumstances, the parents have an important role³².

SURGICAL TREATMENT IN PEDIATRIC PATIENTS WITH DYSPHONIA

In children, laryngeal surgery differs from that in adults in many aspects, particularly regarding anatomy, distinct disorders and assessment. A skilled paediatric anaesthetist is required to provide a secure tubeless field useful for the endoscopy and the surgery on a small larynx^{2,5,15}. Regarding the ideal period of time when to perform laryngeal surgery in children, Landa and colleagues recommend surgical treatment in children over 9 years old for whom the vocal disorder persists after the rehabilitation, particularly if a congenital pathology of the vocal cord is suspected². Alternatively, Hirschberg et al. argues that the perfect time for surgery in children is between 4.5 and 5 years of age⁵.

It was observed that almost 40% of paediatric patients with dysphonia secondary to benign fibrovascular vocal cord lesions do not respond to voice therapy and must undergo other procedures to recover their communication abilities. Blue LASERS target the microvasculature without the overlying epithelium deterioration. This instrument reorganizes the collagen framework in keloids. It has been demonstrated that the photoangiolytic LASER can remodel the vocal cords with benign fibrovascular lesions in children without the need for postoperative voice rest³³.

CONCLUSIONS

To maintain a healthy voice, children should avoid vocal abuse and irritants. They should be encouraged to have quiet time that includes some non-vocal activities during the day, and it is important for them to take singing lessons to develop an appropriate phonation behaviour. The phoniatic pathology of children is a real test for any specialist and it requires teamwork in collaboration with the psychologist, the educator, and their parents.

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