ABSTRACT: Paradoxical vocal fold motion (PVFM), described as inappropriate adduction or closure of the true vocal folds during inspiration and/or expiration, may result in upper airway obstruction and stridor (Andrianopoulos, Gallivan, & Gallivan, 2000; Maschka et al., 1997; Mathers-Schmidt, 2001). Frequently for children, vocal fold adduction during inspiration results in airway hunger. If this experience is sufficiently frightening, subsequent sensations of airway closure may elicit panic attacks. In extreme cases of PVFM, the paradoxical activity of the vocal folds may lead to loss of consciousness. The problem may occur in isolation or in conjunction with other medical problems, such as asthma and reflux, making diagnosis difficult.

Identification of the entity, with subsequent referral for behavioral intervention, has markedly increased in recent years, as evidenced by the growing literature describing client characteristics and treatment plans. PVFM has been documented in males and females of all ages. Although most clients fall between the ages of 10 and 40 years (Kuppersmith, Rosen, & Wiatrak, 1993), it has been diagnosed in children as young as 4 months of age (Heatley & Swift, 1996). Recently, attention has been directed toward child and adolescent athletes (Landwehr, Wood, Blager, & Milgrom, 1996; Powell et al., 2000; Sullivan, Heywood, & Beukelman, 2001). There is little available information in the literature regarding the incidence or prevalence of PVFM in the general population. A recent study by Rundell and Spiering (2003) that evaluated inspiratory stridor (IS), a feature of PVFM, and exercise-induced bronchospasm (EIB) in elite athletes determined an IS incidence of 5%. The complex nature of this problem suggests that it cannot be managed by a single health care provider and instead requires a team of individuals from the schools and health care system.

The goal of this article is to enhance the clinician’s understanding of this disorder and outline a general behavioral management program. Although not a communication disorder, PVFM, as a disorder of the larynx, is best behaviorally managed by the professional with the most comprehensive understanding of the anatomy and physiology of the larynx and extended training in the design and implementation of behavioral management programs. Although behavioral intervention to relax the laryngeal

KEY WORDS: paradoxical vocal fold motion, laryngopharyngeal reflux, inspiratory stridor

Paradoxical Vocal Fold Motion in Children and Adolescents

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mechanism and promote optimal respiratory support is most commonly referred to the speech-language pathologist (SLP) in the medical setting, the role of the school SLP as a resource for this very complex breathing disorder is not minimized. The school SLP will play a crucial role in directing appropriate referrals for the child and monitoring success of the behavioral treatment plan, which is most typically initiated during the assessment process in the medical setting. The treatment, with as few as one to two follow-up sessions, will often result in maximum functional outcome. This dramatic therapeutic response typically does not initiate a full public school individualized educational plan (IEP) process. The most valuable role for the school SLP may be to monitor the child after he or she returns to school activities and sports, support the behavioral program designed at the time of assessment, and educate school staff about the nature and treatment of PVFM.

DIFFERENTIAL DIAGNOSES

One of the most confounding factors in attempting to understand PVFM is the myriad of terms attached to descriptions of the same condition. The literature abounds with other labels, such as vocal cord dysfunction (Altman et al., 2002; Balkissoon & Blager, 2002; Powell et al., 2000; Sullivan et al., 2001), paradoxical vocal cord motion (Maschka et al., 1997), episodic paroxysmal laryngospasm (Gallivan, Hoffman, & Gallivan, 1996), factitious asthma (Downing, Brahman, Fox, & Corrao, 1982), Munchausen’s stridor (Patterson, Schatz, & Horton, 1974), psychogenic stridor (Wareing & Mitchell, 1997), episodic laryngeal dyskinesia (Ramirez, Leion, & Rivera, 1986), and adductor laryngeal breathing dystonia (Blitzer & Brin, 1991). These labels appear, in part, to be a classic example of medical specialists focusing on their area of expertise. For example, it is evident that Munchausen’s stridor and psychogenic stridor suggest underlying psychopathology as the etiology, whereas adductor laryngeal breathing dystonia, as a primary diagnosis, implies underlying neuropathology. Although some practitioners suggest that PVFM is a functional or nonorganic disorder, the extent to which the disorder is functional is unclear. Some patients exhibit panic attacks secondary to the fear of experiencing air hunger; others may have a co-morbid increased level of anxiety such as separation anxiety or overanxious disorder (Gavin, Wamboldt, Brugman, Roelser, & Wamboldt, 1998); still others are mixed. Although the corpus of literature for PVFM suggests that psychological factors may play a role in many cases, firm conclusions regarding this aspect of PVFM are difficult to substantiate (Mathers-Schmidt, 2001). In light of this and the possible neuropathologic and medical etiologies for this condition, it is best to consider PVFM as a complex, heterogeneous disorder in both etiology and expression (Bless & Swift, 1993; Mathers-Schmidt, 2001).

In her comprehensive tutorial, Mathers-Schmidt (2001) identified the primary etiologies of PVFM as including psychological conditions, upper airway sensitivity to laryngeal irritants, and a form of laryngeal dystonia. Although psychological causes are considered primary in many publications on PVFM, the identification of PVFM in infants and small children suggests that there may be multiple possible etiologies (Bless & Swift, 1993). Irritants to the airway are likely triggers for a PVFM event in the pediatric population. These include postnasal drip/sinus drainage; laryngopharyngeal reflux; and/or exposure to irritating gas, smoke, fumes, vapor, mist, or dust (Perkner et al., 1998). Thirty-six to ninety-five percent of children with PVFM exhibit clinical signs of laryngeal tissue changes that are consistent with the occurrence of laryngopharyngeal reflux (LPR; Powell et al., 2000). LPR has been defined as the backward or return flow of stomach acid to the level of the throat. The structures in the throat (pharynx, larynx, and lungs) are more sensitive to stomach acid and digestive enzymes than other tissues of the digestive tract, so smaller amounts of the reflux into this area can result in more damage (Columbia Presbyterian Medical Center, 2002) than might be expected as compared with esophageal mucosa, for example. Children, especially competitive athletes, have very busy schedules and frequently report not eating a meal, eating late at night, eating immediately before their competitive activity, or having more than one competitive activity a day. They also report going to bed late at night. These can be triggers for LPR. Although LPR may be the most predominant trigger for PVFM, the rare neurologic etiology must be considered when making the differential diagnosis. Neurologic causes for PVFM may include brainstem compression, cortical or upper motor neuron injury, nuclear or lower motor neuron injury, or movement disorder (Maschka et al., 1997).

Stridor and airway obstruction secondary to vocal fold adduction are clinical features of PVFM; therefore, physically obstructive laryngeal, tracheal, and pulmonary conditions, some of which are potentially life threatening, must be ruled out before PVFM can be considered. Organic airway obstructive conditions and asthma must be assessed in the initial stages of diagnosis. It is for these reasons that a medical evaluation must be completed before any behavioral treatment begins.

Laryngomalacia, a condition that is most often diagnosed in infancy whereby the cartilages of the posterior larynx are “floppy” and fall anteriorly and posteriorly into the airway during breathing, is one pediatric condition that may cause airway obstruction and noisy breathing at the level of the larynx. Additionally, recurrent respiratory papillomatosis, although rarely documented in infants, may develop in the preschool and school-aged child larynx and/or pharynx and create obstruction while rest breathing and/or during exertion. Voice changes may or may not accompany these conditions. Bilateral vocal fold paralysis, a feature of Chiari II malformation and some other organic brain diseases, may cause airway obstruction and noisy breathing as a result of the close approximation of the true vocal folds at all times, requiring a tracheostomy tube to maintain a patent airway. Congenital laryngeal webbing, tumor, and anomalies of the trachea may also restrict the airway, causing respiratory distress upon exertion while awake or while sleeping. All of these conditions must be
ruled out before a diagnosis of PVFM can be considered as the source of the child’s breathing difficulty.

PVFM co-occurs with asthma approximately 50% of the time (Newman, Mason, & Schmaling, 1995), making the differential diagnosis more challenging. Multiple triggers typically aggravate asthma, whereas PVFM is commonly elicited by only one trigger (McFadden & Gilbert, 1994). Although PVFM and asthma may co-occur and may share common triggers (e.g., exercise, extreme temperatures, airway irritants, and emotional stressors) and associated chest tightness, there are distinct clinical features that differentiate PVFM from asthma, as outlined in Table 1. The clinical features of PVFM described in this section apply to children and adolescents with documented PFVM who are free of organic obstructive laryngeal conditions and pulmonary diseases other than asthma. For young preverbal children, symptoms may include intermittent stridor and respiratory distress while asleep or awake; following emesis; or following exertion, such as crying or passing of stool (Heatley & Swift, 1996). In older children and adolescents, the clinical presentation will likely include the following:

- Episodic stridor occurs primarily for inhalation and sometimes for exhalation.
- The child will describe the primary area of tightness in the throat/larynx.
- Inhalers typically are not effective.
- Stridor and difficult breathing typically subsides when the activity that triggered the event stops.
- Stridor and perceived obstruction are likely to recur shortly after resuming activity.

Most children over the age of 8 who have asthma can clearly distinguish the difference between an asthma attack and PVFM because the locus of tightness differs. School-age children can generally discern the physical differences between the two events and learn how to respond confidently either with the prescribed breathing exercises for PVFM or with bronchodilators for asthma. Some children who have been inappropriately diagnosed with asthma may be gratified to get relief with a relatively simple breathing method rather than taking medications that did not work and had unpleasant side effects. For other children who have long carried the inappropriate diagnosis of asthma, they and their caregivers may express great reluctance in accepting the diagnosis of PVFM, even if the vast amounts of medication taken have not worked. Careful, thorough counseling during the assessment and treatment process will aid with this transition.

THE MANAGEMENT PROCESS

Once it has been determined that the child has symptoms of airway obstruction, it is important that the origin of the problem be determined as rapidly as possible. The initial referral should be made to the child’s primary care physician (PCP) as that doctor is typically the starting point for all patient care. A recommended clinical pathway is described in Appendix A. An explanation of symptoms and reason for referral should accompany the child. A referral checklist is provided for guidance in Appendix B. The checklist may be completed and sent to the PCP for additional support for the child’s initial evaluation.

<table>
<thead>
<tr>
<th>Diagnostic feature</th>
<th>PVFM</th>
<th>Asthma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest tightness</td>
<td>Yes/No</td>
<td>Yes</td>
</tr>
<tr>
<td>Throat tightness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Stridor with inhalation</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Wheezing with expiration</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Types of triggers</td>
<td>Exercise, extreme temperature (hot or cold), airway irritants (gastroesophageal reflux disease and/or postnasal drip), emotional stressors</td>
<td>Exercise, extreme temperature (hot or cold), airway irritants, allergens, emotional stressors</td>
</tr>
<tr>
<td>Number of triggers</td>
<td>Usually one</td>
<td>Usually multiple</td>
</tr>
<tr>
<td>Usual onset of symptoms after beginning exercise (in min)</td>
<td>&lt; 5; however, can be variable</td>
<td>&gt; 5–10 min</td>
</tr>
<tr>
<td>Recovery period (in min)</td>
<td>5–10</td>
<td>15–60</td>
</tr>
<tr>
<td>Response to bronchodilators and/or systemic corticosteroids</td>
<td>No response</td>
<td>Good response</td>
</tr>
<tr>
<td>Nocturnal awakening with symptoms</td>
<td>Rarely</td>
<td>Almost always</td>
</tr>
<tr>
<td>Female preponderance</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

This table was compiled from information gathered from the authors’ clinical experiences and information reported in Brugman and Simons (1998) and Mathers-Schmidt (2001).
The evaluation should include a comprehensive case history intake that addresses the client’s knowledge of his or her symptoms and reason for referral; nature of the breathing difficulty; any previously diagnosed respiratory disease, including asthma or other airway obstruction; effectiveness of inhalers if applicable; and any triggers that precede a PVFM event. Changes in voice quality and swallowing should also be documented. If the child is unfamiliar with reflux terminology, a presentation of symptoms to encourage awareness will be helpful for further identification of onset of event and associated triggers (see Table 2). Medical history and lifestyle questions should be asked, including other medical conditions for which the client is being treated, such as allergies. Other questions involve current medications and any medications that were tried and deemed ineffective; any previous surgeries; and lifestyle habits, such as tobacco exposure and alcohol and caffeine use. This information is part of the picture that will assist in supporting clinical impressions and recommendations.

Questions directed at the onset and symptoms of the breathing attack should include frequency and duration of occurrence, area of physical tightness, whether the breathing difficulty occurs with inhale/exhale or both, what type of noise (if any) occurs during the event, any numbness or tingling of extremities or lips, and if any emergency treatment or hospitalization has been required. Powell et al. (2000) reported that a majority of PVFM in adolescents occurs in females and is largely secondary to daily stressors and gastroesophageal/LPR. Brugman and Simons (1998) reported an approximate 40/60 split between male and female athletes with exercise-induced PVFM. For athletes, the nature of the breathing difficulty relative to the sport(s) that they participate in will be important information for the intervention process. Specifically, does the breathing difficulty limit activity and prevent return to performance?

### Table 2. How to identify and treat symptoms of laryngopharyngeal reflux in children.

<table>
<thead>
<tr>
<th>Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent burping (with or without odor)</td>
</tr>
<tr>
<td>Frequent throat clearing and/or coughing</td>
</tr>
<tr>
<td>Hoarseness, particularly in the morning</td>
</tr>
<tr>
<td>Complaints of indigestion</td>
</tr>
<tr>
<td>Complaints of a lump in throat or difficulty swallowing solids in particular</td>
</tr>
</tbody>
</table>

**Behavioral recommendations for controlling reflux**

- Limit or avoid the following foods, particularly before bedtime or sporting activities: chocolate; mint; caffeine; carbonated beverages; and acidic foods, including but not limited to tomatoes and citrus fruits.
- Leave a span of approximately 2–3 hr between the last meal and bedtime or sporting event.
- Do not eat lying down.
- Do not lie down after eating.
- Raise the head of the bed with blocks or have the child sleep on a wedge.
- Avoid tight-fitting clothes in the area of the waist and/or neck.
- Encourage a healthy diet and weight loss if your child is overweight.
- Consult a physician if problems persist.

### Speech-Language Pathology Assessment and Treatment

When the diagnosis of PVFM is a possibility, an adequate amount of time should be scheduled (60–90 min) for the assessment process. There has been documented evidence that children with PVFM differ from those with asthma in the degree of anxiety that they experience (Gavin et al., 1998). Clinician priority should be to promote client comfort and ease within the evaluation environment. To support the maximum functional outcome, which is management/elimination of PVFM, the child should receive and practice effective therapy techniques at the initial appointment. The SLP should put emphasis on establishing a relationship with the client that embodies trust and clinical competence. Children and caregivers often need to be convinced of the effectiveness of a behavioral approach to treatment, particularly if they have lived with an inappropriate diagnosis and treatment of asthma for some time. It is the job of the SLP to get the client with PVFM invested in the evaluation and treatment from the beginning.

The child may then be referred to an allergist, pulmonologist, and/or otolaryngologist to rule out other airway obstructions or for follow-up care if the child is already receiving medical management from one or all of these professionals. When medical intervention has been initiated and PVFM symptoms persist, a referral to the medical SLP for assessment and treatment is appropriate. For many caregivers, the extensive medical work-up that these children receive may seem unwarranted and intimidating. When working with airway difficulties, it is only after any obstructive conditions as described above or other disease processes have been ruled out that the SLP can be confident of success with behavioral intervention.

PVFM is complex and affects the quality of the child’s life on many levels. The mildest form of PVFM may not affect daily living at all. However, the most severe form, if left untreated, may result in emergency room visits, a hospital stay or, rarely, tracheostomy (Andrianopoulos et al., 2000).

Management of PVFM in children and adolescents, as in adults, requires a multidisciplinary approach. The team may include all or any of the following professionals: PCP, allergist, pulmonologist, otolaryngologist, SLP, gastroenterologist, neurologist, psychiatrist/psychologist, athletic coach, and athletic trainer. In most centers, the medical SLP has the primary role of behavioral therapist within the team of people who evaluate and treat PVFM. In some centers, it is the SLP’s assessment that provides the definitive diagnosis of PVFM. The SLP will discern patterns of laryngeal behavior that contribute to typical and atypical vocal fold posturing for breathing tasks and any musculoskeletal tension during breathing and voicing.
the activity? During this part of the interview, the clinician will obtain valuable information about the nature of the PVFM event and the process of client awareness and attention will begin. It might be the first time the client thought about his or her attacks in such detail.

If the SLP is trained and competent with flexible fiberoptic evaluation of the larynx in accordance with American Speech-Language-Hearing Association (ASHA) training guidelines for videolaryngoscopy/stroboscopy (ASHA, 2004), physical evaluation by the SLP may include flexible fiberoptic endoscopic evaluation of the larynx during breathing maneuvers. It has been suggested that initial evaluation of PVFM in juveniles and adolescents can be performed while the client is asymptomatic (Powell et al., 2000). Most clients who present in a medical clinic with concerns about PVFM do not demonstrate symptoms during the clinical assessment. Evaluation can also be completed following a short burst of medically supervised physical activity, for example, running stairs or running on a treadmill. Flexible endoscopic equipment should be connected with a monitor in a position that allows the client a live view of the examination.

An effective way of beginning the process of increasing awareness and attenuating the fear that often accompanies PVFM is through visual biofeedback during the evaluation. The sensation of PVFM can be frightening and debilitating to a juvenile or adolescent. To minimize this fear, the client should begin by visually identifying and understanding the behavior that needs to be managed (Andrianopoulos et al., 2000; Mathers-Schmidt, 2001), namely the vocal fold closure during inspiration. Explanation of normal vocal fold functioning, visual feedback, and clinician explanation of the paradoxical movement begins the process of relearning and taking responsibility for eliminating the paradoxical behavior. Vocal fold abduction breathing techniques are introduced during the endoscopic evaluation with the purpose of allowing the client to see and feel that he or she can be in control of airway maintenance.

The remainder of the evaluation session is spent explaining and practicing relaxation and attention to stress and tension in relevant muscle groups. Full abdominal breathing exercises and breathing recovery exercises are presented. Breathing recovery exercises are assigned for daily home practice and should be used as needed at the onset of a PVFM attack. Behavioral management of LPR is reviewed in depth, if necessary. The client may be encouraged to keep a journal (Andrianopoulos et al., 2000) of daily influences of stress and tension, diet and exercise, triggers of PVFM events, signs and symptoms of LPR, and attention to breathing throughout the day. Documentation of the nature of the breathing difficulty and completion of the breathing practice cultivates further awareness and responsibility for the breathing disorder. Appendix C provides a generalized behavioral treatment plan for PVFM. The initial step of the behavioral treatment program is based on a convergence of the authors’ personal experiences with progressive relaxation (Jacobson, 1929) and mindfulness (Kabat-Zinn, 1990). The goal of the treatment plan is not simply to promote relaxation, but also to cultivate awareness of the subtle physiological feedback that the body provides to the client signaling that a PVFM event is about to occur. This training is key to the successful implementation of the breathing exercises.

The child or adolescent is typically followed for two to four therapy sessions to further tailor the behavioral plan to the child’s individual requirements. In the authors’ experience, most children respond rapidly to the treatment plan in one or two visits. Those children who require ongoing treatment may require additional support for any or all of the following reasons: poor caregiver support; unwillingness to make lifestyle changes that promote success; medically complex presentation; failure to adhere to the medical, pharmaceutical, and/or behavioral plan as prescribed; inadequate pharmaceutical management of gastroesophageal reflux; and lack of motivation to correct the disorder. Clients are often directed back to the referring physician for further medical management of LPR and/or postnasal drip. By reducing/eliminating the irritants that may be exacerbating the PVFM, the behavioral intervention will be more efficacious.

Each client who presents for evaluation and treatment of PVFM requires individual attention to his or her specific history and development of symptoms. The extent of evaluation is dependent on the symptoms reported, previously completed evaluations from other pertinent team members, and consideration of any additional diagnostic tests that need to be completed to rule out other airway obstruction or medical conditions. The following case study demonstrates the evaluation and treatment process with an adolescent athlete. The evaluating team included her PCP, allergy and asthma specialist, athletic trainer, and SLP.

**CASE STUDY**

A 15-year-old female competitive swimmer presented with a 3-week history of shortness of breath while swimming. She described a wheezy and shaky feeling associated with an irregular breathing pattern. She had difficulty with inspiration and reported a “blockage” in her throat. Her symptoms persisted for 10 min and were noted during pool practice and during competition. Medical assessment by a sports medicine physician indicated that her lungs were clear to auscultation bilaterally, with no wheezing or cough noted with forced expiration. History was negative for allergies or postnasal drip. She was not on any medications, and medical history was otherwise unremarkable. She reported frequent heartburn with regurgitation while swimming and that she typically ate a large snack before practice.

During flexible fiberoptic examination of the laryngeal structure and function, signs of LPR irritation were observed (i.e., swollen, red arytenoids cartilages and swelling of the lower leading edges of the vocal folds). She was able to reproduce the “blockage” and “wheezy feeling” during inhalation. During this maneuver, adduction of the true vocal folds was observed with accompanying stridor. With the flexible endoscope in place, breathing exercises to restore and/or maintain vocal fold abduction were trained. This athlete was able to match the visual presentation of...
her adducted vocal folds with the perception of the “throat blockage” and then visualize how effective the deep nasal sniff during inspiration could be to rapidly abduct her vocal folds. Visual feedback was valuable for the initial training of kinesthetic awareness of localized tension at the level of the vocal folds and then relief of the symptom with the deep nasal sniff maneuver.

Once this kinesthetic awareness was trained, the visual feedback was no longer necessary and the swimmer was able to rely on her perceptions of throat tension and relaxation to monitor success. Whereas basketball players, runners, rowers, and other land-bound athletes readily take to the breathing exercises prescribed, swimmers are more likely to be skeptical that the deep nasal sniff can be executed in the water. This client was no exception. Specific direction to slow her pace in the pool as she learned to coordinate the sniff inhalation in the water before picking up the pace again was an important variation for this athlete to succeed. A home practice schedule was assigned with particular direction to take the time to incorporate the inspiratory sniff into each swim stroke that she used. Additional attention and relaxation work (as described in Appendix C) as well as behavioral management to reduce LPR (see Table 2) was trained (e.g., the client was asked specifically to avoid eating for 2 hr before swimming). The referring physician prescribed medication for LPR, along with a nasal steroid for reducing nasal congestion, which is often experienced by swimmers who are exposed to high levels of chlorine in the pool.

The second visit to the SLP took place 2 weeks after the initial evaluation. The client reported one PVFM event during the 200 individual medley; however, she was able to recover from the event by applying the breathing exercises she had practiced previously in and out of the pool. She was then able to use her exercises to recognize her unique physiological triggers (i.e., feeling of regurgitation into her throat and subsequent throat tightness) that typically lead to a PVFM event and quickly start the deep nasal sniff with oral exhale, thereby completely preventing subsequent attacks throughout the rest of the swim meet. She reported complete confidence in her ability to prevent and treat PVFM as needed, having experienced success in the pool when under the pressure of competition. The tightening/relaxing exercises outlined in the client handout (and in Appendix C) helped her identify when the breathing difficulties were beginning. This awareness prompted her to start the breathing maneuver before she escalated into a full-blown race-ending PVFM event. She continued to practice her exercise program daily, both in and out of the pool, and reported complete resolution of her symptoms to her athletic trainer within the following 2 weeks.

**CONCLUSION**

PVFM is a complex disorder of the larynx that has varied etiologies. It is increasingly identified in the pediatric population, particularly among high achievers who may or may not be involved in competitive sports. Often mistaken for having asthma, these children require special attention for quick and accurate diagnosis of this predominately behavioral disorder, application of medical and behavioral intervention, and creation of a rapid pathway to recovery. For those children who have PVFM along with diagnosed asthma and/or allergies, the treatment pathway is more complex; however, the ability to discern the difference between PVFM and asthma or allergies followed by the appropriate application of the breathing exercises will have a positive, lasting impact on the child’s quality of life. The continuum of care for the child with PVFM is yet another important example of how the school SLP can collaborate with the medically based SLP for early identification and comprehensive treatment that quickly leads to complete resolution of the disorder in most children. Children who successfully respond to therapy are less likely to miss school, require fewer emergency room visits or hospitalizations, experience less stress and anxiety, and enjoy athletic activities more. With the ongoing research and significant information available regarding this breathing disorder and its many variations, those who experience, as well as those who diagnose and treat, PFVM, can be optimistic for the long-term functional outcome associated with proper medical and behavioral management.

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APPENDIX A: CLINICAL PATHWAY FOR THE REFERRAL AND TREATMENT OF PARADOXICAL VOCAL FOLD MOTION

Child with symptoms of PVFM

Referral to primary care physician/pediatrician/sports medicine to begin evaluation and referral process

Asthma/allergy/pulmonology/otolaryngology specialist

Asthma under control, PVFM symptoms persist

Evaluate and treat asthma, airway obstruction if present

Medical management of airway obstruction if present

Airway obstruction managed effectively, PVFM symptoms persist

PVFM eval with SLP in medical setting

Behavioral and medical management

2–4 follow-up visits or as needed

Management and resolution of PVFM

Unresolved symptoms

Refer for further medical work-up
APPENDIX B. REFERRAL CHECKLIST FOR SCHOOL STAFF

If a child presents with one or any combination of the following symptoms that result in apparent airway obstruction and/or inability to continue activity, the speech-language pathologist would talk to the child’s parent or caregiver about referral to the child’s primary care provider (PCP) for initiation of medical management to rule out paradoxical vocal fold motion (PVFM). It is recommended that you communicate with the PCP as to the reason for referral and include this checklist for documentation purposes.

Student: __________________________________________________________
Date: _____________________________________________________________
Time of event: _____________________________________________________
Treatment provided: _________________________________________________
Treatment provided by: ______________________________________________

Symptoms:
- Asthma symptoms that do not follow their usual pattern
- Breathing status not restored with prescribed inhalers
- Intermittent shortness of breath
- Shortness of breath with neck tightness
- Shortness of breath during and/or following physical activity
- Shortness of breath during and/or following eating
- Voice changes during activity
- Choking sensation
- Intermittent wheezing or stridor
- Reported throat tightness

APPENDIX C. GENERAL BEHAVIORAL PROGRAM TO DECREASE/ELIMINATE PARADOXICAL VOCAL FOLD MOTION AS DESIGNED BY THE UNIVERSITY OF WISCONSIN–MADISON DIVISION OF OTOLARYNGOLOGY VOICE CLINIC

The following exercise plan is a regime that will require adjustment to meet the needs of the individual. These specific exercises are recommended in the sequence described three to four times per day for 5 minutes per practice. All three steps should be followed during dedicated practice time. Practice should be conducted in a manner to maximize the child’s ability to attend to the task. Therefore, caregivers and educators should help the pediatric patient with PVFM structure quiet, uninterrupted time for practice. Only Step 3 will be used during an actual breathing attack.

Step One – Tightening/Relaxing Exercise

Developing an awareness of muscle/throat tightness and learning to relax these muscles is a key skill to alleviate the breathing difficulty. Discovering additional physical information about the body that signals the development of throat tightness will help the child start the breathing exercises before he or she escalates into a full PVFM event. Although these exercises may seem designed to promote only relaxation, they are also designed to train attention to muscle changes in the body. Follow this exercise sequence as described while seated or lying down. When tightening the various muscle groups, hold the tension as tight as possible. The goal is to recognize localized tension and then release the tension in order to develop better awareness of PVFM triggers.

- Tighten the muscles in your feet. Notice the feeling of tightness in the muscles of your feet. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your feet. Feel the relaxation in your feet.
- Tighten the muscles in your calves/lower legs. Notice the feeling of tightness in the muscles of your calves. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your calves. Feel the relaxation in your lower legs.
- Tighten the muscles in your thighs. Notice the feeling of tightness in the muscles of your thighs. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your legs. Feel the relaxation in your legs.
- Tighten the muscles of your buttocks. Notice the feeling of tightness in the muscles. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your bottom. Feel the relaxation. Notice the difference between tightness and relaxation.
- Tighten the muscles of your hands by making fists. Notice the feeling of tightness in your hands. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your hands. Feel the relaxation in your hands. Notice the difference between tightness and relaxation.
- Tighten the muscles in your shoulders by shrugging your shoulders up to your ears. Notice the feeling of tightness in your shoulders. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your shoulders. Feel the relaxation in your shoulders. Notice the difference between tightness and relaxation.
- Tighten the muscles in your jaw by clenching your teeth together. Notice the feeling of tightness in the muscles of your jaw. Hold the tension for a count of five. Release the tension in these muscles and notice the tightness leave your jaw. Feel the relaxation in your mouth and jaw. Notice the difference between tightness and relaxation.

continued on next page
Many people who experience difficulty breathing will benefit from lower, relaxed breathing that fills the part of the lungs below the shoulders, armpits, and upper chest—not just the upper lung area near the shoulders. Many children tighten the neck and shoulder muscles in response to air hunger, thereby exacerbating the experience of throat tightness. Follow this exercise sequence while imagining the tension leave your forehead. Notice the difference between tightness and relaxation.

Tightening of the throat area was not included in this program as it is the authors’ experience that many children are concerned that this may trigger a PVFM event.

Parents, partners, or caregivers may read this slowly to the patient to assist with this tightness/relaxation exercise.

Step 2 – Establish Low Breathing

Many people who experience difficulty breathing will benefit from lower, relaxed breathing that fills the part of the lungs below the shoulders, armpits, and upper chest—not just the upper lung area near the shoulders. Many children tighten the neck and shoulder muscles in response to air hunger, thereby exacerbating the experience of throat tightness. Follow this exercise sequence while imagining the tension leave your forehead. Notice the difference between tightness and relaxation.

Tightening of the throat area was not included in this program as it is the authors’ experience that many children are concerned that this may trigger a PVFM event.

Parents, partners, or caregivers may read this slowly to the patient to assist with this tightness/relaxation exercise.

Step 3 – PFVM Breathing Recovery

This is the actual breathing maneuver that will be applied when the first trigger of a PVFM event is identified. Steps 1 and 2 are key building blocks to success with Step 3. If Step 3 is difficult, it might be because the first two steps of this sequence have not been mastered. Being able to breathe in through the nose is important for this step. If the nose is plugged, take measures to get and keep it open if possible. The doctor may have recommended a nasal spray or use of a neti pot (i.e., hypertonic saline nasal irrigation system) to keep the nose from swelling closed. If the nose is permanently blocked, the speech-language pathologist will need to adjust this exercise.

- Practice sniffing in deeply through your nose. The deep nasal sniff should be relaxed without any shoulder raising or a lot of upper chest movement.
- Practice sniffing in quickly and deeply. One big sniff or two or three quick sniffs that rapidly follow one another are both useful ways to get air into your body by quickly opening up your vocal folds, the source of your breathing difficulty.
- Now pair the deep sniff in with the belly breathing that was described in Step 2. In other words, see if you can sniff air into your body, all of the way down to your belly button. See if you can do it without raising your shoulders up toward your ears.
- Next, after you take a nice, deep sniff of air into your body, make sure to exhale while making any of the following sounds for up to a count of 8-10: “s, sh, or f.” This step is important to keep your throat open when you exhale. You must exhale as completely as possible to avoid hyperventilation. Athletes will not be able to exhale slowly when engaged in vigorous exercise.

The deep sniff in, followed by the slow, complete exhale, is the actual breathing exercise that should be used during a PVFM event or when the first trigger is identified. It is vital that this breathing exercise is initiated at the first sign of an event. Athletes will require specific adjustment of this exercise to match the requirements of their sport. For example, runners perform at a level of physical exertion that requires rapid movement of air through an open throat, making the nasal sniff difficult at peak performance; swimmers experience swelling of the nasal passages, requiring a nasal steroid to maintain an open nose; basketball players often report particular difficulty with PVFM during skill drills or when sprinting down the court, requiring specific attention to these occasions; rowers may experience more difficulty with allergies to molds or other environmental allergens in the training space; and cyclists may have more difficulty with LPR due to the forward seated posture. The goal is to keep the events from getting worse and, eventually, keep them from happening at all.