Case Report, Case Reports

Stress velopharyngeal incompetence: Two case reports and options for diagnosis and management

Nikhila Raol a, Gillian Diercks a, Cheryl Hersh b, Christopher J. Hartnick a,∗

a Department of Otolaryngology, Massachusetts Eye and Ear Infirmary, Harvard Medical School, Boston, MA 02114, USA
b Department of Speech Language Pathology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA

ABSTRACT

Stress velopharyngeal incompetence (SVPI) commonly affects brass and wind musicians. We present a series of two patients who presented with nasal air emission following prolonged woodwind instrument practice. Neither patient demonstrated audible nasal air emission during speech, but endoscopy revealed localized air escape/bubbling from different sites for each patient with instrument playing only. Both underwent tailored surgical treatment with resolution of symptoms during performance. Diagnosis of SVPI requires examination during the action that induces VPI to allow for directed management. Treatment should be targeted based on nasopharyngoscopy findings.

1. Introduction

First described by Weber and Chase in 1970 [1], stress velopharyngeal incompetence (VPI) is a unique type of velopharyngeal dysfunction that occurs due to high intraoral pressures that may occur while playing brass or woodwind instruments. The pressures generated can be as high as 30-times as those generated with normal speech production [2], resulting in the undesired audible nasal escape. For these musicians who participate in competitive or very high-level performance, particularly for many years, considerable strength and stamina of the muscles of the velopharyngeal closure mechanism is imperative. When these muscles are unable to meet those demands, stress VPI may result.

Symptoms of stress VPI include nasal air leak or audible nasal air emission heard while playing. Those symptoms most often arise after extended periods of play, which can cause velar fatigue. The most common instruments which have been noted to be associated with stress VPI include oboe, trumpet, tuba, clarinet, bassoon, and French horn [2].

Multiple surveys have demonstrated the frequency of this problem among musicians based on symptoms alone. A 2007 survey by Malick et al. reported a 34% rate of previous or currently existing stress VPI amongst college musicians [2]. In addition, a 2011 survey of collegiate level musicians by Evans et al., 39% of respondents reported that they had personally previously experienced or were experiencing stress VPI, and 30% reported knowing another musician who had personally experienced stress VPI [3]. However, the number of reported cases in the literature of treatment for this condition is low [1,4–10], suggesting that despite knowledge of this entity, a small number actually seek medical attention.

While awareness of the problem exists among woodwind musicians, it is still a problem that can be difficult to identify unless the precise circumstances under which it occurs are reproduced. If the patient can be examined while stress VPI is present, the source of insufficiency can be identified to guide treatment planning. Here, we describe two woodwind instrument players who experienced stress VPI after long periods of playing. We will demonstrate appropriate exam technique and nasopharyngoscopy findings necessary to diagnose stress VPI as well as present management options.

2. Case no. 1

A 15-year old male saxophone and clarinet player with no past medical history presented to the speech-language pathologist (SLP) with sudden onset of nasal air emission (NAE) during clarinet playing only, which began following a prolonged period of clarinet practice (9 h/d preparing for an audition). Subsequently, his
practice time decreased to 2 h per day; however, he continued to have distracting and bothersome NAE, which seemed to be becoming more pronounced. Interestingly, he reported normal speech with no audible air escape during regular conversation, and he had no significant NAE while playing the saxophone. On SLP evaluation, the patient demonstrated mild hypernasality with connected speech, but emission was undetectable during conversational speech. During performance on the clarinet, audible, distracting NAE with fogging of a mirror at the left nostril was noted. Nasometry revealed a nasalance score of 51–53% during clarinet playing, in contrast to normal nasalance scores of 10–15% during speech production efforts (Table 1). Nasalance is defined as the following:

\[ \text{Nasalance} = \frac{\text{Height of nasal passage}}{\text{Height of oral passage}} \times 100 \]

where the total acoustic energy is the combination of the nasal and oral acoustic energy. Of note, no normative values currently exist for nasalance scores while playing an instrument. Normative values for speech production are about 10–14%.

The patient was subsequently referred to pediatric otolaryngology. Nasopharyngoscopy was performed to evaluate velopharyngeal closure during normal speech and with clarinet performance (Fig. 1). Exam demonstrated complete velopharyngeal closure with a coronal closure pattern with speech. On the Golding-Kushner scale [11], right and left palate movement ratings of 1.0 were noted, left and right lateral wall movement of 0.3 and 0.2 were noted, and no significant posterior pharyngeal wall movement was noted. However, nasopharyngoscopy while playing the clarinet demonstrated constant air escape and bubbling on the left, with decreased left lateral pharyngeal wall movement (Golding-Kushner rating of 0.2) [11]. Closure decreased from 100% to approximately 80% with clarinet playing. The patient attempted a 16-month trial of modifications including a period of clarinet rest with transition to the saxophone, which required lower intraoral pressure. In addition, he participated in intermittent treatment sessions to modify oral nasal balance at an outside facility without success. These sessions focused on the use of discrimination, biofeedback for airflow, facilitation of phonemes and phoneme contrasts, nose-pinch techniques, increased volume, and attention to oral articulators [12,13]. Based on the location of the air escape, he underwent left unilateral sphincter pharyngoplasty. Repeat exam four weeks after surgery demonstrated a decrease in nasalance score while playing to 40%, with no appreciable change in nasalance during speech production. While 40% is typically considered mild VPI when referring to speech production, given the lack of normative data for stress VPI, the significant improvement in the nasalance score was regarded as an indicator of successful treatment. Most importantly, audible nasal emission was no longer perceptible with playing. Given the significant improvement on the first musical task (Chromatic scale), the patient was not tested on the longer piece of music postoperatively (see Table 1).

3. Case no. 2

A 16-year-old female oboe player with no past medical history presented to the SLP with a history of intermittent nasal air emission while playing long musical compositions. The problem primarily began during a music camp, where she was practicing 7 h/d for several consecutive days. Symptoms did not resolve when her practice patterns returned to normal upon returning home. The patient demonstrated no problems with speech intelligibility but did report hypernasal speech for several minutes following clarinet playing when NAE were induced. SLP exam revealed nasalance scores during speech for both single utterances and connected speech within normal limits: marginally higher than the mean values, but below the first standard deviation from the mean. There was no NAE detected via nasal mirror exam during production of pressure dependent consonants in connected speech (Rainbow passage [14]). However, with oboe playing, increased nasalance of up to 43% was noted with longer musical compositions (New World passage, see Table 1); these were not present with short scale work, consistent with the patient’s experience. She was subsequently examined by a pediatric otolaryngologist, who performed nasopharyngoscopy during normal speech and during oboe performance. During normal speech, complete closure was

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Preoperative nasalance score</th>
<th>Postoperative nasalance score</th>
<th>Normal values (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal speech</td>
<td>Bilabials (p, b) ^</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Alveolar sounds (t, d) ^</td>
<td>11.5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Velar sounds (k, g)</td>
<td>13.5</td>
<td>13</td>
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<tr>
<td></td>
<td>Sibilant sounds (s, sh) ^</td>
<td>11.5</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Rainbow passage no. 1 ^</td>
<td>20</td>
<td>Not performed</td>
</tr>
<tr>
<td>Performance</td>
<td>Scale no. 1: “Chromatic Scale” ^ ^ ^</td>
<td>53</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Weber no. 2 ^ ^ ^</td>
<td>46.5</td>
<td>Not performed</td>
</tr>
<tr>
<td>Case 2</td>
<td>Preoperative percent nasal leakage</td>
<td>Postoperative percent nasal leakage</td>
<td></td>
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<tr>
<td>Normal speech</td>
<td>Bilabials (p, b) |</td>
<td>&lt;1 SD above the mean</td>
<td>Not performed</td>
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<td></td>
<td>Alveolar sounds (t, d) |</td>
<td>&lt;1 SD above the mean</td>
<td>Not performed</td>
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<td></td>
<td>Velar sounds (k, g)</td>
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<td>Not performed</td>
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<td></td>
<td>Sibilant sounds |</td>
<td>&lt;1 SD above the mean</td>
<td>Not performed</td>
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<tr>
<td></td>
<td>Rainbow passage no. 1 |</td>
<td>&lt;1 SD above the mean</td>
<td>Not performed</td>
</tr>
<tr>
<td>Performance</td>
<td>C-major scale</td>
<td>38</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>New world piece ^ ^</td>
<td>43</td>
<td>29</td>
</tr>
</tbody>
</table>

^ Mackay-Kummer SNAP test [18].
\| Represents connected speech, contains 11% normally nasal phonemes [14].
\| \| A musical scale with 12 pitches, each a semitone above or below another.
\| \| \| Clarinet Concerto No. 2 in E flat major, Op. 74, 1811, by Carl Maria von Weber.
\| \| Excerpt from new world symphony, formally known as the symphony no. 9 in E minor, “From the New World,” Op. 95, 1893, by Antonín Dvořák.
noted with a coronal closure pattern. Exam while playing the oboe revealed a slight decrease in velar movement, with a resultant central gap and 90% closure (pinhole defect per Golding-Kushner scale [11]) (Fig. 2). The patient opted to proceed immediately with surgical intervention given the detrimental effects that the NAE were having on her ability to perform. Based on the location of the air escape, she underwent a calcium hydroxypatite injection to add bulk to the posterior pharyngeal wall. Repeat SLP exam two weeks postoperatively demonstrated resolution of NAE and reduction in nasalance on nasometry to 29% (Table 1). Tests for which nasalance scores were within one standard deviation of the mean were not performed again postoperatively. She has remained symptom-free six months after surgery.

This study was deemed exempt by the institutional review board.

4. Discussion

There have been 12 cases of stress VPI described in the English-language medical literature, most recently in 2012 [1,4–10,15]. Approximately two-thirds of these cases have been treated surgically, with a number of surgical procedures described, including sphincter pharyngoplasty, inferiorly and superiorly-based pharyngeal flaps, lipoinjection of the soft palate, and Teflon injection into the posterior pharyngeal wall [6–10]. While it appears, based on case reports, that surgical management is effective, the diagnosis of this entity still poses a problem. A 2007 survey by Malick et al. of approximately 200 otolaryngologists and plastic surgeons revealed that only 27% of these physicians had seen a patient with symptoms of stress VPI, with only 45% being familiar with the term stress VPI [2]. As a result, a likely manageable problem that can be career-ending may go underdiagnosed and undertreated. Our cases highlight the importance of recognizing the problem, accurately diagnosing the source of velopharyngeal insufficiency through nasopharyngoscopy during tasks that reproduce stress VPI, and tailoring surgical management to each musician’s source of stress VPI. This allows for a reduction in NAE without negatively impacting normal speech or instrument performance.

An important caveat to make regarding this condition is that the degree of impact on quality of life (QOL) is critical to determine. As noted previously, many musicians are familiar with the entity, but based on its relatively small presence in the VPI literature, it is likely that a small proportion of patients actually seek treatment. One could predict that only avid players with a significant decrease in QOL would be interested in therapy. QOL tools, such as the Velopharyngeal Insufficiency Effects on Life Outcomes (VELO) developed by Skirko and Sie [16], can help to determine at what stage patients may benefit from intervention.

Familiarity with the entity is essential, as recognizing the symptoms alone can make the diagnosis. According to a 2014 Delphi survey of health practitioners who treated musicians with stress VPI, the most important tools for assessment of stress VPI were history and nasopharyngoscopy, with self-reported symptoms being identified as most significant indicator of the disorder [3]. With both of these cases, the diagnosis was clear simply from the history. Exam with both an SLP and a pediatric otolaryngologist can confirm the diagnosis, with nasometry findings establishing a baseline of the degree of incompetence and endoscopy confirming presence or absence of an anatomic defect, as opposed to functional incompetence.
In addition, nasopharyngoscopy is the key to identifying the site of air escape. Use of a standardized rating system, such as the Golding-Kushner rating scale [11] used to describe the area of deficiency in our patients, can help characterize the anatomic defect in a systematized fashion. In our two patients, nasopharyngoscopy showed different findings, leading to different, but effective, surgical treatments. In addition, the extent of necessary treatment was tailored. For instance, a lateral gap due to poor lateral wall motion may be treated with a sphincter pharyngoplasty, but given that there was only unilateral air escape, a less extensive single-sided procedure was performed. This likely avoids any detrimental side effects of surgery. Pharyngeal flap may have been considered; however, given the small gap and its location, limited impact on conversational speech, and risk of obstructive sleep apnea, this option seemed like excessive. Though posterior pharyngeal wall augmentation was another option, in the senior author’s experience, injections have been better served for direct midline small velopharyngeal gaps, such as after adenoïdectomy, and less effective for lateral gaps where the injected material seems to migrate slightly and therefore affect long term success rates. Likewise, with the second patient, a pharyngeal flap could have been considered for treatment of a central gap. However, given the small size of the gap and the central location of the gap, an injection proved effective. These points are particularly important to note in woodwind/brass musicians, as any change in airflow may affect aspects of instrument playing.

It is important to note that surgery is not necessarily the treatment for all patients with this condition. In fact, if a structural deficiency is identified by an otolaryngology, recommendations from performance science literature state “some cases may benefit from employing specific exercises done away from the instrument and by using a structured practice plan upon returning to playing activities. A guided rehabilitation program can be designed with advice from a health professional in collaboration with both music teacher and student [17].” This may involve changing the practice session length, incorporating breaks, proper warm-up and cooldown, and slowly increasing the difficulty level of the music [17].

5. Conclusion

Stress VPI is an entity that occurs occasionally in wind musicians but can be difficult to diagnose and treat if one is not armed with the right tools for identifying the problem. A careful history and physical examination are essential, and nasopharyngoscopy during the VPI-causing task is invaluable in helping to identify the location of NAE in order to customize the management plan for each patient. Our two patients had classic presentations, and endoscopic exam allowed for individualized and effective treatment.

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Conflict of interest statement

None.

References