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Velopharyngeal insufficiency

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Introduction

Velopharyngeal insufficiency (VPI) is a failure of the body's ability to temporarily close the communication between the nasal cavity and the mouth, because of an anatomic dysfunction of the soft palate or of the lateral or posterior wall of the pharynx. It is an uncommon problem that typically manifests in patients as hypernasal speech, increased nasal resonance, nasal regurgitation, and nasal emission during phonation. It can be caused by a variety of disorders (structural, genetic, functional or acquired) and is very often associated with a cleft palate.

Loney and Bloem(1987) reported that there are multiple meanings in the literature for "velopharyngeal inadequacy" and "velopharyngeal insufficiency."They noted that three terms are often used interchangeably, but in other instances they are used with one term representing a general category of all velopharyngeal malfunctions and the other two as delimiting categories within the general term. Loney and Bloem (1987) use a forth term, "velopharngeal dysfunction" as the general behavioural category that includes all type of presumed causes.[1] Loney and Bloem point out that, having three terms used in a redundant and contradictory manner hinders efficient scientific discourse, especially when the nomenclature is by many members of multidisciplinary team. They suggest that everyone adopt the following usage of the terms.

Velopharyngeal insufficiency: Any malfunctioning that results in imperfect closure of the velopharyngeal apparatus.Velopharyngeal insufficiency includes both velopharyngeal incompetence and velopharyngeal inadequacy.

Velopharyngeal incompetency: Imperfect closure of the velopharyngeal apparatus that is caused by a defect in neuromuscular functioning rather than a deficit tissue.

Velopharyngeal inadequacy: Imperfect closure of the velopharyngeal apparatus that's caused by deficit tissue.

However, their definition point out assumption in common theory that may act to inhibit further insight. A first concern with definition proposed by loney and Bloem is that an important diagnostic decision for patients manifesting velopharyngeal dysfunction is captured by a dicotomy between neuromotor cause and reduced tissue causes. A second concern is that the definitions cited earlier depend on quantitative measurements that we do not usually have. Perhaps the simplest approach would be use the terms velopharygeal incompetence, velopharyngeal insufficiency, velophayngeal inadequacy, and even velopharyngeal dysfunction as synonyms

Normal anatomy

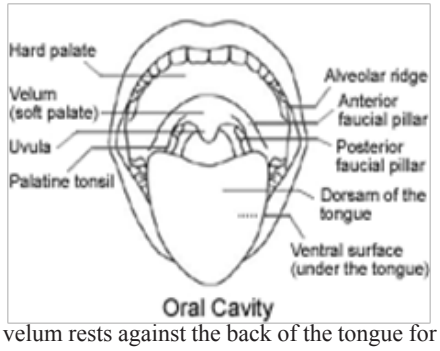
Normal velopharyngeal function[2]

To understand velopharyngeal dysfunction, you need to first understand normal velopharyngeal function for speech. The velopharyngeal valve is very important for normal speech production. This valve is made up of the following structures:

a. Velum (also called soft palate)

b. Lateral pharyngeal walls – the side walls of the throat

c. Posterior pharyngeal wall – the back wall of the throat



The velum rests against the back of the tongue for nasal breathing. This allows the air that is inhaled through the nose to go through the throat (pharynx) to the lungs and back up again (Figure 2).

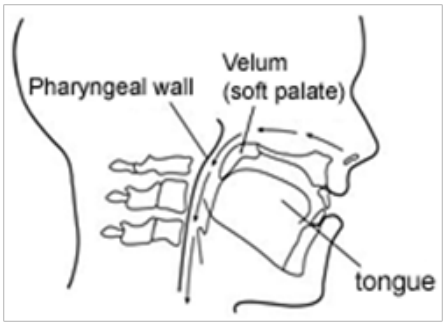


Figure 2 Velum during nasal breathing.

The velum closes against the back wall of the throat during speech. The side walls close against the velum so that all of these come together as a valve. When the velopharyngeal valve closes, the air and sound are sent into the mouth for speech (Figure 3).

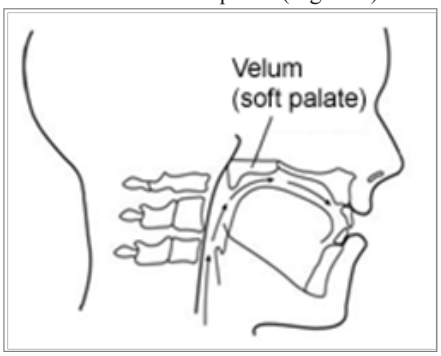


Figure 3 Velum during normal speech.

Pathophysiology

Oral resonance (as contrasted to nasal resonance) is obtained by velopharyngeal closure (VPC), a seal between the nasopharynx and the oral cavity. Typically VPC is accomplished by elevation of the velum and approximation of the lateral walls to close off the nasopharynx. In a small group of patients, formation of a Passavant ridge on the posterior pharyngeal wall may contribute to closure. Velopharyngeal dysfunction (VPD) describes what happens when velopharyngeal closure is impaired.

1. Effects of VPD on a patient's speech include:
2. hypernasality; decreased speech intelligibility; and nasal emissions (i.e., air escape out of the nose during speech).
3. How severely a patient's speech is affected depends on several factors, including the following:

a. The amount of gap with a closed velum

b. The patient's articulation and oral motor ability

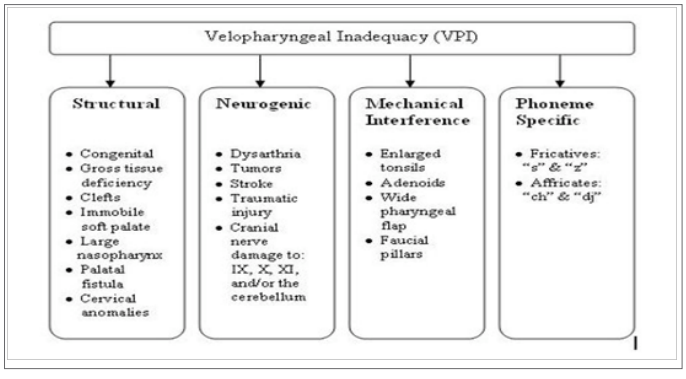
c. Compensatory strategies the patient may have developed to decrease nasal emission or hypernasality.

Common compensatory strategies include: speaking with soft intensity (i.e., volume) to decrease airflow through the nasal cavity; speaking with loud intensity or pushing to try to project the voice; and substituting phonemes that require less airflow for the correct phoneme.[3]

Etiology

Etiology of velopharyngeal inadequacy or deficiency is broadly classified into[4]

1. Structural
2. Neurogenic
3. Mechanical interference
4. Phoneme specific



Signs and symptoms

There are several ways in which speech can be affected. Speech may sound hypernasal (more air resonating in the nose than there should be). Because air is escaping into the nasal cavity, there may be insufficient air pressure in the mouth while talking resulting in weak speech sounds and unclear/distorted articulation (speech sound production). Sometimes we may notice compensatory articulations. Non-speech sounds that are created when desired sounds cannot be produced are: Nasal air emissions (irregular snorts/bursts of air from the nose) during speech, loss of liquids through the nose while drinking and nasal grimace (a tightening of the facial muscles during speech which may look effortful) are other signs/symptoms of VPI:[5]

1. Hypernasality - Speech that sounds overly nasal, as if the person is "talking through his/her nose."
2. Hyponasality - A lack of normal nasal sounds during speech
3. Nasal air escape - Air escaping from the nose during speech
4. Reduced oral pressure for pronouncing consonants
5. Compensatory Articulation including:

a. Glottal stop - The glottis is the gap between the vocal folds that is closed up in the production of certain sounds.

b. Pharyngeal fricatives - A type of consonant sound produced during speech

c. Nasal rustle and posterior nasal fricatives (also called nasal "snorts")

Air escaping from the nose when certain sounds are pronounced.[6]

Diagnosis

An incorrect diagnosis can lead to insufficient differential management. Most surgeons have their own vision on diagnosis and differential management. Several methods can be used to diagnose velopharyngeal inadequacy.

Speech analysis

The first thing that is evaluated is the quality of speech of the patient, also known as speech analysis.[7,8] It is the gold standard test in VPI evaluation. In speech analysis speech scientist listens to the voice, articulator, motor speech and velopharyngeal function of the patient. Hypernasality of the voice i.e. patient is unable to create normal resonance because of nasal air emission is the main symptom.

Nasometry

Nasometry is a test which calculates a ratio between the nasal and oral sound emissions. The ratios of the patient will be compared with normal ratio and standard deviation. These ratios will determine whether the operation was a success. Preoperative ratios will becompared with post operative ratios[9] The physician also examines the patient for obstructive sleep apnea syndrome (OSAS). When this is positive, the patient will be treated for OSAS first.

Nasoendoscopy

Nasoendoscopy is a non-radiographic technique in which the physician uses a scope to enter the mouth of the patient. Nasoendoscopy provides an overview of the anatomy of the velopharynx during phonation. With nasoendoscopy the vocal tract but especially the soft palate and the lateral wall of the pharynx can be visualized.[10] Not only the location but also the movement can be visualized with nasoendoscopy.[11] Limitations of nasoendoscopy is, it is hard to get an overview with rigid scope in small children,[8] especially when there are abnormalities and obstructions in the nasal cavity , which are frequently found in children with cleft palate, also it can cause irritation of the mucosa.

Videofluroscopy

Videofluoroscopy provides an overview of the lateral and posterior walls of the pharynx, this technique also provides information about the length and movement of the soft palate, the posterior and the lateral walls.[10–12] A limitation of multiview videofluoroscopy is the possibility of misinterpreting certain shapes of gaps and anatomic structures.[11–13] The most frequently used diagnostic tools are videofluoroscopy and endoscopy.

Magnetic resonance imaging

MRI is non-radiographic and non invasive and therefore can be repeated more often in short periods of time.[9] limitations of MRI are artefacts can be seen on the images when the patient moves while imaging and in patients who has orthodontic appliances. It is limited in children who are claustrophobic.

Treatment of velopharyngeal insufficiency

Physical therapy

The main objective of physical treatment is to achieve adequate velopharyngeal (VP) function and normal oralnasal resonance (Figure 4).

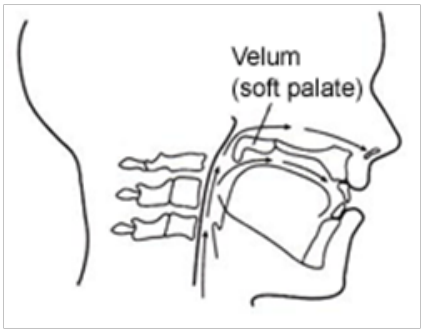


Figure 4 Velopharyngeal insufficiency(velum is too short for closure).

Speech therapy

Ruscello(14) addressed the issue of speech therapy for improving velopharyngeal closure. Described a variety of techniques including experimental approaches with CPAP and biofeedback, but the primary emphasis was on the use of "oral-motor therapy," labeled as NSOME (nonspeech oral motor exercises), such as blowing, sucking massage, etc.

Surgical techniques

Normally when the patient has VPI, first of all the palatum will be closed. If speech is not as aimed, palatoplasty will take place. This is an operation in which the velopharyngeal port is narrowed down and functionally improved. Velopharyngeal insufficiency remains in 5-20% of the patients who underwent surgery for closing the palatal cleft.[13] Therefore, a secondary operation is necessary. Nowadays the procedure that is chosen the most from the palatoplasties is the pharyngeal flap or sphincter palatoplasty.[14]

Pharyngeal flap

It is a flap of the posterior wall is attached to the posterior border of the soft palate. The flap consists of mucosa and the superior pharyngeal constrictor muscle. The muscle stays attached to the pharyngeal wall at the upper side (superior flap) or at the lower side (inferior flap).[13] The function of the muscle is to obstruct the pharyngeal port at the moment that the pharyngeal lateral walls move towards each other.[13–15] If the width of the flap is too wide, the patient can have problems with breathing through the nose, which can result in sleep apnea.

Sphincture palatoplasty

In spincture palatoplasty both sides of the superior-based palatopharyngeal mucosa and muscle flaps are elevated.[16,17] Because the distal parts (posterior tonsillar pillars, which the palatopharyngeal muscles are attached to)[15] are sutured to the other side of the posterior wall, the pharyngeal port will become smaller. As a result, the tissue flaps cross each other, leading to a smaller port in the middle and a shorter distance between the palate and posterior pharyngeal wall.[13] Pharyngeal flap surgery is not better than sphincter palatoplasty.[13]

Posterior wall augmentation

This technique can only be used for small gaps.[18] When this operation is performed there are several advantages. It is possible to narrow down the velopharyngeal port without modifying the function of the velum or lateral walls.[19] The chance of obstructing the airway is lower in this technique, because the port can be closed more precisely. Many materials have been used for this closure: petroleum jelly, paraffin, cartilage, adjacent soft tissue, silastic, fat, Teflon and proplast.[15] Disadvantage with the techingue is there are problems with tissue compatibility.

Non-operative technique

Prosthesis

Prosthesis is used for non surgical closure in a situation of velopharyngeal dysfunction. It is good option for patients that have enough tissue but a poor control of the coordination and timing of velopharyngeal movement.[15–19] It is also used in patients with contraindication for surgery. It has also been used as a reversible test to confirm whether a surgical intervention would help.[15] Some authors have hypothesized that prostheses may stimulate neuromuscular activity,[20] though definitive proof for this hypothesis is lacking.[21] The main types of prostheses include the following:

1. Palatal lift
2. Speech bulb/obturator
3. Nasal valve

Devices that include features of both lifts and obturators (so-called lift-orators) also exist. Palatal lifts (see the images below) are used when adequate palatal length exists but dynamic motion of the palate is poor as a consequence of neuromuscular etiologies. Palatal lifts reduce the distance the palate must traverse to produce adequate closure. An obturator is usually necessary when the velum is short and scarred, and the ratio of velar length to nasopharyngeal depth is excessive, such as seen in some patients with repaired cleft palate. Obturators can substitute for tissue deficiency and are attached to the palate or teeth. In certain cases, the obturator can be downsized gradually so that the native tissue, if adequate in bulk, can strengthen over time and compensate for the decreasing obturator size. A combined prosthesis (lift-orator) is useful when elevation of the velum alone is not sufficient to achieve closure. Such speech prostheses are fitted under endoscopic control by an interdisciplinary team that includes a prosthodontist, an SLP, and an endoscopist. The

nasal valve is an appliance fitted to each nostril.[22] A one-way valve on either side allows the patient to breathe in through the nose, but stops nasal airflow with exhalation or speech.

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Noen.

Conflict of interest

The author declares that there is no conflict of interest.

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