

PARADOXICAL VOCAL CORD MOTION:
AN ALARMING STRIDOR FOR
A BENIGN CONDITION

- Case Reports -

ABDUL-LATIF HAMDAN^{*}, ROGER V. MOUKARBEL^{**}
AND MARWAN YOUSSEF^{**}

Abstract

Paradoxical vocal cord motion presents a challenge to medical practitioners in various specialties. Physicians in general and anesthesiologists should suspect this condition in a patient presenting with stridor or a history of choking or asthma not responding to medical treatment. Women are usually more affected than men and more often there is history of anxiety and/or a precipitating factor such as cough or hyperventilation. Accurate diagnosis relies on visualizing adduction of the vocal cords during inspiration or throughout the respiratory cycle using fiberoptic nasopharyngeal laryngoscopy or telescopic examination.

The etiology varies from organic causes such as brainstem compression or lower motor neuron injury to non-organic causes such as malingering or conversion disorders. The pathophysiology is believed to be accentuation of the glottic closure reflex.

From Dept. of Otolaryngology-Head & Neck Surg., American Univ. of Beirut Medical Center, Beirut, Lebanon.

* MD, FACS, Clinical Assoc. Prof.

** MD, Resident.

Corresponding Author: Abdul-Latif Hamdan, MD, FACS, American University of Beirut, Department of Otolaryngology. P.O. Box: 11-0236. Tel/Fax: 961-1-746660. E-mail: alhamdan@svelb.com.

Many modalities of treatment are available ranging from sedation, voice therapy and breathing exercises to Heliox administration, Botulinum toxin type A injection, intubation and at times tracheostomy.

Key Words: Stridor, Paradoxical Vocal Cord Motion, Asthma.

Introduction

Paradoxical vocal cord motion is rare entity that presents a challenge to medical practitioners in various specialties. Pulmonary physicians describe it as factitious asthma or hysterical asthma because of poor response to bronchodilators. Otolaryngologists have used terms such as irritable larynx syndrome or functional airway obstruction with the belief that it is a hyperfunctional disorder of the thyroarytenoid muscle precipitated by the inhalation of chemical or other irritants. Anesthesiologists often refer to this entity as episodic paroxysmal laryngospasm witnessed following endolaryngeal manipulation^{1,2,3}. This diversity in terminology has further confused the diagnosis of this frustrating condition, yet the clinical presentation remains the same, alarming and frightful. Anesthesiologists are often misled by the symptoms. What is paradoxical Vocal Cord Motion?

We would like to present two cases of paradoxical vocal cord movement, discuss the clinical presentation, pathophysiology, diagnosis and treatment of this rare entity.

Case Reports

Case 1: A 62 year old lady not known to be hypertensive, cardiac or diabetic presented with history of choking sensation precipitated by emotional stress or cough. Patient also described stridor with inability to breath during the attack which lasts for minutes and subsides on no treatment. Patient is known to have allergic rhino sinusitis for which she received antihistamines with decongestants. She also reported history of heartburns and regurgitation suggestive of gastro-esophageal reflux for

which she received a proton-pump inhibitor. Patient was suffering from severe depression because of chronic illness that has affected her son. Fiberoptic nasopharyngeal laryngoscopy revealed normal vocal cords mobility with absence of glottic or supraglottic lesions. Laryngeal video-endostroboscopy was normal. Patient was admitted to the hospital for assessment and work-up of her condition. During her stay she suffered from a stridorous attack. Repeated nasopharyngeal laryngoscopies during the attack revealed adduction of the true vocal cords during inspiration and expiration. Patient was reassured and given a positive feed-back that she is doing well and consequently the vocal cords resumed normal function and started abducting during inspiration. Patient was informed about her condition and was discharged home on an anxiolytic medication. On follow-up she did well and reported complete resolution of her symptoms.

Case 2: A 90 years old lady presented with history of stridor and inability to breath that affected her daily activity. The attacks came sporadically with no obvious precipitating factor. She denied any other complaints and did not suffer from any chronic illnesses except for hypertension and gastro-esophageal reflux disease for which she was receiving treatment. Patient underwent in and outside hospital all kinds of diagnostic work-up including magnetic resonance imaging (MRI) of the head and neck, Computerized Tomography (CT) of the neck and chest, esophagoscopy and bronchoscopy, all of which were normal. Fiberoptic nasopharyngeal laryngoscopy revealed initially mild abduction of the true vocal cords during inspiration and few seconds later adduction during which she became stridorous (Figure 1 and Figure 2). Patient was reassured during the attack and subsequently the symptoms subsided in few seconds and the true vocal cords resumed normal mobility. Laryngeal video-endostroboscopy did not show any abnormality. Patient was advised psychoanalysis and voice therapy.

Fig. 1

A fiberoptic laryngoscopic view of a 74 year old female with paradoxical vocal cord movement showing complete adduction of the true vocal cords during inspiration resulting in an audible stridor. Please note the diamond shape appearance posteriorly.



Fig. 2

A fiberoptic laryngoscopic view of the same patient when she was symptom free, i.e. not during the attack.



Definition

In early 1974 Christopher et al was the first to report involuntary adduction of the vocal cords during inspiration⁴, however the term paradoxical was used only in 1978 by Rogers et al. Since then sporadic attacks of stridor during activity have been associated with the entity of paradoxical vocal cord motion⁵. Adults are affected more than pediatrics with a major predominance for middle-aged females in the paramedical field. Affected males are usually achievers and invariably there is a positive history of anxiety or personality disorder⁶. Juvenile paradoxical vocal cord dysfunction has also been reported with an average age of 14,5 years. Girls are again more affected than boys (82%), and close to half of them play competitive sports and have history of important social stress⁷.

Patients usually describe a choking sensation with inability to breath resulting in an audible inspiratory and/or expiratory sound, i.e.stridor. Wheezing may or may not be present. They may describe tightness in the neck and sometimes in the chest. The attack usually may last seconds to minutes. More often there is a precipitating or an inducing factor such as hyperventilation, cough, panting, phonatory tasks or the inhalation of irritants or perfume, or any oropharyngeal or laryngeal manipulation prior or post extubation. Stress by itself is commonly reported prior to the attacks⁸.

All of our patients had history of choking and inability to breath. In one case the attacks were precipitated by cough, and emotional stress whereas in the other there were no precipitating factors. Change in voice quality, dysphonia or complete aphonia may occur but was not present in our cases.

Many co-existing physiologic abnormalities and diseases may be present. These include brainstem abnormalities, functional disorders, neurologic compromises, cystic fibrosis and vagal neuropathy^{9,10,11}. Asthma is very commonly associated with paradoxical vocal cord motion. Close to 10% of patients with asthma may have paradoxical vocal cord

motion and almost half of patients with paradoxical vocal cord motion have asthma^{12,13}. None of our cases had history of asthma, however both had allergic rhino sinusitis. Gastro-esophageal reflux disease has been attributed to most benign as well as malignant vocal cords lesions. It plays a major role in both organic and functional voice disorders and has been incriminated heavily in most hyperfunctional laryngeal disorders¹⁴. In our two cases, patients had history of gastro-esophageal reflux disease that was treated with a proton pump inhibitor.

Diagnosis

A high index of suspicion is needed to unravel a patient's condition. Proper awareness of this entity can spare the patient needless diagnostic tests and invasive therapeutic interventions. Inappropriate and dangerous long-term treatment can also be avoided. Diagnosis of paradoxical vocal cord motion relies on the proper visualization of the inspiratory and expiratory activity of the true vocal cords during a stridorous attack^{4,8}. This visualization can be seen using either indirect or direct laryngoscopy. Fiberoptic nasopharyngeal laryngoscopy or telescopic examination of the larynx will reveal paradoxical adduction of the vocal cords during inspiration or throughout the respiratory cycle. A persistent posterior diamond shaped chink as seen in our cases is invariably present. Although pathognomonic, abnormal adductory vocal fold movement during asymptomatic periods of normal breathing have been documented¹⁵. Laryngeal electromyography of the thyroarytenoid and posterior cricoarytenoid muscles has also shown an increase in activity. This brings up the question whether paradoxical vocal cord motion is a chronic disease or an episodic one. A question that remains to be answered.

Videolaryngoscopy may show a posteriorly positioned epiglottis in 36% of the cases, significant anteroposterior constriction in 41% and abnormal false vocal cords adduction in 45%⁷. These findings strongly suggest an increase in muscle tension pattern described earlier by Koffman et al¹⁶. In our first case there was antero-posterior constriction

and mild false cords adduction during inspiration. Posterior glottic changes such as interarytenoid edema and frank pachyderma have also been reported and explained on the basis of laryngopharyngeal reflux disease^{7,14}. The vocal cord functional pattern is usually normal during vocalization except in cases of dysphonia or aphonia where edema of the membranous component of the true cords can be seen. These endoscopic findings are in parallel with the acoustic analysis results reported by Murray et al showing an increase in perturbation parameters and an increase in noise to harmonic ratio¹⁷. None of our cases had vocal changes or presented with dysphonia.

A laryngeal video-endostroboscopic study conducted on fifty adults with history of paradoxical vocal cord motion seen between the attacks revealed unstable zero phase reflecting an increase in cycle to cycle variation in frequency, decreased amplitude of vibration, decreased mucosal waves and asymmetry¹⁵. These findings further support the hypothesis that paradoxical vocal cord motion is a continuum of laryngeal instability. Laryngeal video-endostroboscopy performed on the two cases presented did not show any abnormalities.

Metacholine/histamine bronchoprovocative tests have also been used for the diagnosis of paradoxical vocal cord motion with failure of response to anti-asthmatic medications¹⁸. Flow volume loops study shows attenuation of the inspiratory flow suggesting an extrathoracic airway obstruction. Blood gases are usually within normal.

Radiologic investigation with computed tomography and magnetic resonance imaging of the head, neck and chest are usually normal and non revealing⁸, as shown in case 2.

The differential diagnosis of paradoxical vocal cord motion includes laryngeal dyskinesia, bilateral vocal cord paralysis, hereditary abductor paralysis, interarytenoid web and cricoarytenoid joint fixation. Patients with exertional dyspnea should also be investigated for paradoxical vocal cord motion. Multiple system atrophy and autonomic dysfunction disorders such as Shy-Drager syndrome have had also nocturnal stridor or sleep apnea syndrome¹⁹.

Classification and Pathophysiology

In the early seventies, paradoxical vocal cord motion also described as episodic laryngospasm was considered under the classification scheme of hyperkinetic laryngeal function reported by Morrison et al. Muscular tension dysphonia, chronic cough, throat clearing and globus pharyngeus were other symptoms listed as secondary to hyperactivity of intrinsic laryngeal muscles²⁰. In 1997, Maschka et al from the University of Iowa came with a more complete classification of paradoxical vocal cord motion²¹. These were grouped according to the etiology as being (a) organic such as brainstem compression, upper or lower motor neuron disorders or movement disorders, and (b), non-organic such as factitious or malingering paradoxical vocal cord motion and conversion disorders

The pathophysiology of paradoxical vocal cord motion is believed to be neurophysiological keeping in mind the psychological background of the patients affected. It is believed to be due to accentuation of the glottic closure reflex⁸. There is an augmentation of the normal physiologic response triggered by an extrinsic or intrinsic stimulant such as an inhaled irritant, allergies, reflux, stress or other emotional triggers.

It starts by excitation of sensory receptors in the upper aerodigestive tract followed by mediation of this afferent information to the brainstem by sensory neuropeptides. This information is integrated at the level of the nucleus tractus solitarius before it is communicated by second order neurons to the efferent limb that starts at the nucleus ambiguus to generate the glottic closure reflex. This theory is substantiated by the fact that laryngospasm can be induced in animals by injecting substance P (a class of sensory neuropeptide) into the nucleus tractus solitarius²². Interference with the laryngeal innervation due to surgical manipulation, local trauma to the larynx or endotracheal manipulation has also been reported to induce paradoxical vocal cord motion in patients following thyroidectomy²³.

Treatment

The most important element in the treatment of paradoxical vocal cord motion is patient's education. Knowing that many cases are self-limiting with an average duration of symptoms 40,5 months is comforting¹⁷. Psychoanalysis followed by psychotherapy to unravel psychological disorders and emotional disturbances is necessary for each case.

Many modalities of treatment ranging from simple sedation, laryngeal control therapy to tracheostomy have been reported in the literature^{24,25,26}. Speech and voice therapy combined with breathing exercises with or without nasolaryngoscopic biofeedback are extremely useful. The usage of Heliox (80% helium, 20% Oxygen) to reduce the stridor and continuous positive airway pressure to splint the upper airway have also been described. Anti-allergic and anti-reflux therapy should always be contemplated as adjunctive therapy. Botulinum toxin type A injection into each cord is also an alternative in patients who are cooperative²⁷. As an anesthesiologist, intubation and possible tracheostomy should be avoided and should be kept as the last resort only in patients who desaturate and fail.

Conclusion

As a physician dealing with the upper airway, the entity of paradoxical vocal cord motion should always be kept in mind in patients presenting with an acute alarming stridor or a chronic history of wheezes not responding to the conventional asthmatic medications. A prior history of asthma and/or depression or psychological disturbances should prompt the caring physician to request close observation for possible examination of the patient during the attack. A laryngoscopic visualization of the vocal cords dysfunction is essential for a proper diagnosis, a rightful step that will spare the patient unnecessary and elaborate tests and interventions such as intubation or possible tracheostomy.

References

1. HAMMER G, SCHWINN D, WOLLMAN H: Postoperative complications due to paradoxical vocal cord motion. *Anesthesiology*; 66:686-7, 1987.
2. MURRAY DM, LAWLER PG: All that wheezes is not asthma: Paradoxical vocal cord movement presenting as severe acute asthma requiring ventilatory support. *Anaesthesia*; 53:1006-11, 1998.
3. KELLMAN RM, LEOPOLD DA: Paradoxical vocal cord motion: An important cause of stridor. *Laryngoscope*; 92:58-60, 1982.
4. CHRISTOPHER KL, WOOD RP, ECKERT RC, ET AL: Vocal-cord dysfunction presenting as asthma. *N Engl Med*; 308:1566-70, 1983.
5. ANDRIANOPOULOS MV, GALLIVAN GJ, GALLIVAN KH: PVCM, PVCD, EPL and irritable larynx syndrome: what we are talking about and how do we treat it? *J Voice*; 14:607-18, 2000.
6. WOOD RP, MILGROM H: Vocal cord dysfunction. *J Allergy Clin Immunol*; 98:481-5, 1996.
7. POWELL DM, KARANFILOV BI, BEECHIER KB ET AL: Paradoxical vocal cord dysfunction in juveniles. *Arch Otolaryngol Head Neck*; 126(1):29-34, Jan 2000.
8. ALTMAN KW, SIMPSON CB, AMIN MR, ET AL: Cough and paradoxical vocal fold motion. *Otolaryngol Head Neck Surg*; 127(6):501-11, Dec 2002.
9. WARD PW, HANSON DG, BERCI G: Observations on central neurologic etiology for laryngeal dysfunction. *Ann Otol Rhinol Laryngol*; 90:430-1, 1981.
10. YOUNGER DS, LANGE DJ, LOVELACE RE, ET AL: Neuromuscular disorders of the larynx. In: Blitzer A, Brin MF, Sasaki CT, et al., eds. *Neurologic Disorders of the Larynx*. New York: Thieme; 1992.
11. KUPPERSMITH R, ROSEN DS, WIATRAK BJ: Functional stridor in adolescents. *J Adolesc Health*; 166-71, 1993.
12. CHRISTOPHER KL, WOOD RP, ECKERT C, ET AL: Vocal cord dysfunction presenting as asthma. *N Engl J Med*; 308:1566-1570, 1983.
13. BAHRAINWALA AH, SIMON MR: Wheezing and vocal cord dysfunction mimicking asthma
14. KOUFMAN JA: The otolaryngologic manifestations of gastroesophageal reflux disease (GERD): a clinical investigation of 225 patients using ambulatory 24-hour pH monitoring and an experimental investigation of the role of acid and pepsin in the development of laryngeal injury. *Laryngoscope*; 101(53):1-78, 1991.
15. TREOLE K, TRUDEAU MD, FORREST A: Endoscopic and stroboscopic descriptions of adults with paradoxical vocal fold dysfunction. *J Voice*; 13:143-52, 1999.
16. KOUFMAN J, BLALOCK D: Functional voice disorders. *Otolaryngologic Clin North Am*; 24(5):1059-73, 1991.
17. MURRAY T, ROSEN CA, CAMPOS A, ET AL: Multifactorial assessment and treatment efficacy of paradoxical vocal fold motion disorder. Presented at *Annual Meeting of the American Broncho-Esophagological Association*; May 14, 2001.
18. BUCCA C, ROLLA G, SCAPPATICCI E, ET AL: Histamine hyper-responsiveness of extrathoracic airway in patients with asthmatic symptoms. *Allergy*; 46:147-53, 1991.
19. UMENO H, UEDA Y, MORI K, CHUJIWA K, NAKASHIMA T, KOTBY N: Management of impaired vocal fold movement during sleep in a patient with Shy-Drager syndrome. *Am Jour of Otolaryngol*; 21(5):344-8, 2000.
20. MORRISON M, RAMMAGE L, EMEMI AJ: The irritable larynx syndrome, *J Voice*; 13:447-55, 1999.
21. MASCHKA D, BAUMAN N, MCCRAY P, ET AL: A classification scheme for paradoxical vocal cord motion. *The Laryngoscope*; 107:1429-35, 1997.

22. BAUMAN NM, WANG D, SANDLER AD, ET AL: Response of the cricothyroid and thyroarytenoid muscles to stereoactic injection of substance P into the region of the nucleus tractus solitarius in developing dogs. *Ann Otol Rhinol Laryngol*; 109:1150-6, 2000.
23. HARBISON J, DODD J, MCNICHOLAS W: Paradoxical vocal cord motion causing stridor after thyroidectomy. *Thorax*; 55:553-4, 2000.
24. NEWMAN KB, MASON UG 3RD, SCHMALING KB: Clinical features of vocal cord dysfunction. *Am J Respir Crit Care Med*; 152(4 pt 1):1382-6, 1995.
25. ARCHER G ET AL: Inspiratory vocal cord dysfunction, a new approach I treatment. *Eur Respir J*; 15:617-8, 2000.
26. BLAGER FB: Treatment of paradoxical vocal cord dysfunction. *SID3 Newsletter*; 5:8-11, 1995.
27. MAILLARD I, SCHWEIZER V, BROCCARD A, DUSCHER A, LIAUDET L, SCHALLER MD: Use of Botulinum Toxin type A to avoid tracheal intubation or tracheostomy in severe paradoxical vocal cord movement. *Chest*;118(3):874-6, 2000.

