Chapter 16
Arytenoid collision in contact ulcer granuloma formation observed by HSDP

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Abstract

To understand possible reasons for acquiring contact ulcer granuloma (CUG), its elimination by various procedures, and/or its post-treatment recurrence, we studied CUG using High Speed Digital Phonoscopy (HSDP). HSDP allows detailed observations of the manner in which posterior glottis collides during phonatory onset. Findings suggest that the manner of arytenoid collision (i.e., parallel vs. off-axis) is crucial in causation and elimination of CUG.

Keywords: HSDP, contact ulcer granuloma (CUG), collision off-axis

Introduction

Contact ulcer granuloma (CUG) of the vocal folds (VF) is a chronic condition presenting predominantly in males. CUG can be unilateral or bilateral. The etiological factors are unclear. However, excessive and violent pressure (trauma) on the mucosa of the medial arytenoid surfaces is suspected as a primary cause. This process of mucosal breakage is followed by spontaneous healing during which granulomatous tissue forms at the site of injury.

Once established, CUG interferes chronically with glottic approximation, promotes more frequent throat clearing, causes dysphonia, may evoke localized or referred pain (i.e., otalgia) to the ipsilateral ear, and interferes with normal glottic mobility. This condition is also considered by some clinicians to be caused or aggravated by gastroesophageal reflux disease (GERD/GORD). However, consistent elimination of CUG with long-term usage of anti-GERD medication has not been documented. In fact, a report on 249 consecutive patients diagnosed with GERD related changes in the larynx and laryngopharynx showed that “in all patients no restoration of normal voice was noted after treatment despite disappearance of the gastrological symptoms” [1]. Some clinical reports show success after GERD control or show efficacy in speeding up recovery and/or in reducing the number of consecutive surgeries when post-surgical voice therapy (VTx) and pharmacological treatment are given in tandem [2-5]. This latter finding has been observed by us as well when CUG is small, as opposed to large CUG, or when bilateral CUG lesions are not present. We are unable to state whether GERD medication or VTx was instrumental.

In males, CUG treatment can be very frustrating. It can require multiple microscopic surgical ablations, medications, and other intervention treatments. Treatment may often span several years and recurrence may be frequent, making CUG management challenging for all parties involved [2-5].
Compared to the male population, CUG is rare in the female population. When present, it is usually found in post-operative cases and is attributed to arytenoid mucosal trauma caused by endotracheal intubation. In women, CUG is typically self-limiting, as it clears typically within 3–5 months or a bit faster if voice conservation regimen is imposed.

Recently, Botox® injection unilaterally into the thyroarytenoid (TA) muscle (i.e., the major adductor intralaryngeal muscle), has been used successfully in selected cases to address otherwise treatment-resistant CUG. Botox weakens the posterior arytenoid collision force by semi-lateralizing one VF by means of chemodenervation for a period of 3–4 months [2]. Better results can be achieved when Botox is supported by VTx. Intralvesional injections of steroids have also proven effective in some conventional treatment-resistant cases.

If CUG is unilateral and in the incipient, early stage, it can also be eliminated by VTx alone. Physiologically focused VTx [5] is based on the reduction of collision force in the posterior glottis. This knowledge of how the arytenoids collide and how they exert pressure on the mucosa is of clinical interest. To follow this logic, we hypothesized that non-parallel (i.e., off-axis) contact of the arytenoids is the cause of mucosal soft tissue abrasion and subsequent CUG formation. We felt that, if we could document this phenomenon, we will be more justified in our claim that trauma is the culprit in CUG formation.

Consequently, we addressed the mechanics of arytenoid contact in a patient with frustrating history of CUG, treated by voice rest (VR), VTx, GERD medications, surgery, and Botox®. A successful outcome was eventually achieved. To prove our hypothesis, we used High Speed Digital Phonoscopy (HSDP) to demonstrate the manner in which the arytenoids collide in CUG, before and after successful treatment.

Case

In April 2009, a 35-year-old male presented with an initial diagnosis of left, medium-sized CUG. Based on his clinical history the onset was in all probability in November 2008. Causation was unclear, but heavy voice usage at work and on a race boat was implicated. Following the initial ENT exam, VR was prescribed. VR involved less than one hour per day of talking Monday through Friday during the workday only. No talking was allowed whatsoever at night, on weekends, and on the boat (he was an avid sailor in a club and used his voice excessively during racing sailboat races). This regimen was followed for approximately three months.

This patient survived his social isolation by using Apple iChat® with family and friends. They would talk with him and he would respond by typing. Subsequent re-examination showed no reduction of CUG by this treatment regimen. In July 2009, he was placed on a high dose of Zantac®, continued on VR, and was sent for an in-depth voice evaluation [5]. Following the voice evaluation, VTx was advised and introduced.

By August 2009, his left CUG was reduced, however a small CUG was now noted on the right arytenoid (Figure 1). He was then advised to use a voice amplifier and lavaliel microphone, and to focus on VTx, by practicing soft voice onset as much as possible. He continued on modified voice rest (MVR), but due to work requirements began increasing voice use during workday to several hours, using soft onset technique when he felt it was appropriate at work.

Using this approach his more recent right, small CUG began to shrink despite increasing amounts of voice use. By December 2009, the right CUG was completely resolved despite his return to a full-time voice use at work. During the healing phase, he did not drink any milk, alcohol, or caffeine drinks. He returned in May 2012 for a follow-up stating he felt that “something was going bad”, since February 2012, after talking loudly at a very noisy restaurant. A recurrence of CUG was found on laryngeal examination.
He was again advised to significantly reduce voice use during the workday and to use a soft voice onset. He was advised to keep total VR at nights and on weekends. These modifications initially produced some decrease in size of his right CUG. However, after a period of heavy work and work travel, the granuloma significantly increased in size by July 12, 2012.

He was then treated with Botox® injection five days after this exacerbation was identified. On post-injection re-examinations the granuloma was first noted to be decreased in size, and was subsequently noted to be resolved within ten days post-injection. A somewhat breathy and moderately aperiodic voice resulted from this Botox® injection. This lasted for four weeks, then his voice improved in terms of clarity, albeit slowly. It continued to improve more rapidly over the following eight to ten weeks.

**Voice therapy (VTx) goals**

The aim of VTx was for him to habituate soft voice onset and a “parallel” rather than “off-axis” posterior closure of the glottis. Our theory was that a parallel closure would significantly reduce pressure on the arytenoid mucosa and hence will eliminate or prevent CUG formation. HSDP confirmed “off-axis” arytenoids contact (Figure 2).

![Figure 1. Location of right CUG.](image1)

![Figure 2. Off-axis posterior closure.](image2)
Throughout his treatment this patient underwent meticulous LVS and HSDP exams focused on how he approximated his posterior glottis. This information was used to implement VTx practices and exercises. Despite our extensive experience in interpreting images and LVS analysis, we could not clearly evaluate the actual trajectory of posterior glottic adduction from LVS alone. Specifically we were unable to “measure” the actual onset of contact of the arytenoids at the voice onset moment.

We assumed that as long as the closure is “parallel” it will reduce or eliminate pressure points on the mucosa and will “cure” CUG. When the closure was “off-axis,” then CUG would persist or return. Type of approximation, i.e., parallel vs “off-axis”, was the theoretical staple of our VTx protocol, hence the visualization of the manner of posterior closure which regulates pressure on the arytenoid surfaces was of main interest for our project. To achieve this goal we used HSDP.

HSDP

Our idea of physiologic VTx approach based on reduction of potentially traumatic posterior glottis approximation was in need of verification. Conventional LVS lacked the precision necessary to adequately observe this maneuver. So we employed HSDP, recorded at 2000 fps, as it allows nearly real time observations of voice onset. HSDP clearly revealed the manner of posterior closure, off-axis or parallel, as illustrated in Figure 3.

Next we processed these recordings using the Vocalizer® system (Figure 4) to demonstrate symmetry of vibration between the left and right VF. We were of the opinion that such pattern of closure is responsible for reduction and/or complete elimination of traumatic posterior commissure collision. Hence, we felt that symmetry of VF vibration is a pivotal factor in preventing recurrence of CUG.

Once parallel closure is habituated, we believe it will prevent recurrence of CUG despite heavy voice usage as such closure eliminates excessive pressure points on the arytenoid mucosa. HSDP and subsequent kymography demonstrated that parallel closure of the arytenoid can be achieved via VTx. His last exam was in December 2013. His voice was normal and there was no evidence of recurrence. He was followed up on regular basis until Fall of 2015 with no recurrence.

Figure 3. On-axis “parallel” posterior glottic closure.
Conclusions

We interpret these HSDP data as evidence for improved adduction of the glottis and for the reason of elimination of the recurrence of CUG in this case, despite his return to a heavy voice usage. To assure that achieving parallel glottis closure is efficacious, more clinical examples are required.

References
