Chapter 27
VSK assessment of selected mucosal dysphonias

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Abstract

Based on videostrobokymographic (VSK) examination of over 1200 dysphonic patients we made qualitative assessments of vocal fold (VF) behavior from multiline kymographs and calculated open (OQ) and closed quotients (CQ) for a variety of benign VF pathologies. Statistical analysis showed correlation between OQ and localization of the phonatory lesion within the glottis. For most patients significantly higher OQ were calculated for anterior, middle, and posterior parts of the glottis when compared to the control group.

Keywords: Videostrobokymography, benign VF pathologies, open and closed quotients

Introduction

Here we present our findings on VF behavior in selected benign VF mucosal pathologies observed with VSK.

Materials and methods

The material discussed here included 1276 exams. Of these, 1176 were dysphonic cases and 100 were normal controls. All cases were examined at the Audiology and Phoniatrics Clinic of the Institute of Physiology and Pathology of Hearing in Kajetany, Warsaw, Poland. Among the dysphonic patients, 430 cases presented with vocal nodules, 276 with polyps, 395 with Reinke’s edema, 40 with cysts, and 35 patients presented with sulcus vocalis.

All underwent laryngovideostroboscopic (LVS) exams made with the EndoSTROB DX Xion 327 unit (Xion GmbH Berlin, Germany, EU) with transoral rigid scope approach. Recordings were made during production of sustained phonation of the vowel /i/. All kymograms were calculated from these four-second long recordings using the Xion equipment. All kymograms were based on three line placements representing anterior, middle, and posterior areas of interests. From these VSK, we calculated both the OQ and CQ for all the pathologies studied.

Results

Based on this large database we observed statistically significant variants in the value of OQ in patients with benign VF pathologies (Table 1). For most patients regardless of VF pathology type, significantly higher OQ (0.6-0.8) were calculated from anterior, middle, and posterior parts of the glottis when compared to the control group (normal voices). Presence of the pathology at an OQ calculation site resulted in a significant reduction in the OQ value. Statistical analysis showed correlation between OQ and localization of the lesion within the glottis [1].
Table 1. Mean values of OQ for different groups of benign VF pathologies and for the control group measured from the anterior, middle, and posterior third of the VF.

<table>
<thead>
<tr>
<th></th>
<th>Anterior</th>
<th>Min, Max</th>
<th>Middle</th>
<th>Min, Max</th>
<th>Posterior</th>
<th>Min, Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>0.56</td>
<td>0.41, 0.68</td>
<td>0.55</td>
<td>0.42, 0.67</td>
<td>0.59</td>
<td>0.4, 0.71</td>
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<tr>
<td>Nodules</td>
<td>0.51</td>
<td>0.37, 0.67</td>
<td>0.57</td>
<td>0.41, 0.68</td>
<td>0.68</td>
<td>0.54, 0.83</td>
</tr>
<tr>
<td>Polyp</td>
<td>0.62</td>
<td>0.54, 0.71</td>
<td>0.49</td>
<td>0.26, 0.78</td>
<td>0.56</td>
<td>0.49, 0.78</td>
</tr>
<tr>
<td>Reinke’s edema</td>
<td>0.30</td>
<td>0.29, 0.72</td>
<td>0.57</td>
<td>0.74, 0.74</td>
<td>0.60</td>
<td>0.00, 0.78</td>
</tr>
<tr>
<td>Cyst</td>
<td>0.6</td>
<td>0.48, 0.73</td>
<td>0.59</td>
<td>0.48, 0.69</td>
<td>0.74</td>
<td>0.66, 0.81</td>
</tr>
<tr>
<td>Sulcus</td>
<td>0.74</td>
<td>0.67, 0.82</td>
<td>0.81</td>
<td>0.78, 0.83</td>
<td>0.78</td>
<td>0.74, 0.83</td>
</tr>
</tbody>
</table>

Calculations of normative values were used in the differential diagnosis process and in evaluation of rehabilitation progress after clinical voice intervention (i.e., therapy and/or surgery). These values were contrasted against mean OQ values for the normal controls. The normal group OQ were 0.56 (anterior), 0.55 (midline), and 0.59 (posterior). The mean value calculated for these three segments was 0.56 (Figure 1). Below we present findings for the separate groups of dysphonias with benign pathologies.

Figure 1. VSK in a normal control voice.

Vocal nodules (VN)

LVS images of VN recordings are shown in Figures 2-1 and 2-2. In this case, the VN were situated at the anterior third of the glottis. The values of OQ on the anterior area were lower when compared to the middle and to the posterior segments of the VF (Figures 2-3, 2-4, and 2-5).

VSK in this patient with VN showed left-right VF asymmetry and a slightly diminished amplitude on the right compared to the left VF. OQ was foreshortened and oscillations were irregular.

The left-right asymmetry was most apparent at the middle segment of the glottis. A slightly reduced vibratory amplitude was also noted on both sides. Oscillations were irregular and there were differences in periodicity.

Asymmetry continued at the posterior segment as well. There were also amplitude differences. Diminished amplitude was noted on both sides, but more on the right VF. For the group, irregular oscillations were common and a full glottic closure was absent.
Figure 2-1. VN VF in abduction.

Figure 2-2. VN VF in adduction.

Figure 2-3. VSK in a patient with VN, anterior segment of the VF (OQ = 0.59)
Figure 2-4. VSK in a patient with VN, middle segment of the VF (OQ = 0.66).

Figure 2-5. VSK in a patient with vocal nodules, posterior segment of the VF (OQ = 0.80).

VF polyp (VP)

LVS images for a VP case are shown in Figures 3-1 and 3-2. In this case, the lowest value of OQ was observed at the anterior area of the glottis, which corresponded to the location of lesion at the anterior segment (Figures 3-3, 3-4, and 3-5). For the group of VP, the lowest values of OQ were obtained typically for the middle area. This area was the most frequent area for a VP location.

A significantly shortened open phase, reduced amplitude on the left (polyp) side, and phase asymmetry were present at the anterior segment.

Moreover for the group, the left-right asymmetry was consistent in all VP cases. Amplitude of the mucosal wave on the left VF was smaller compared to the right VF. Phase asymmetry, irregular oscillations, and differences in periodicity were also present at the middle portion.

As shown in Figures 3-4 and 3-5, a shortened closed phase was seen at the third oscillation cycle.

At the posterior segment the left-right asymmetry, phase shift, irregular oscillations and shortened closed phase were observed. Also amplitude on the left VF was clearly smaller compared to the right VF.
Figure 3-1. VP of the left VF in abduction.

Figure 3-2. VP of the left VF in adduction.

Figure 3-3. VSK in a patient with VP of the left VF, anterior segment of the VF (OQ = 0.61).
Figure 3-4. VSK in a patient with VP of the left VF middle segment of the VF (OQ = 0.57).

Figure 3-5. VSK in a patient with VP of the left VF posterior segment of the VF (OQ = 0.70).

Reinke’s edema (RE)

LVS images for Reinke’s edema are shown in Figures 4-1 and 4-2. In RE the lowest value of OQ was observed in the middle third of the VF, which corresponded to a larger extension of swelling within this segment of the VF (Figures 4-3, 4-4, and 4-5). Combined analysis of parameters obtained from many patients with RE in our study showed statistically significant correlation of OQ at the anterior part of the glottis compared to the control group. LVS showed that the most frequent location of RE in our population was at the anterior portion of the VF.

VSK from the anterior and middle segments of the VF in RE show left-right asymmetry, smaller amplitude on the less affected VF (here shown on the left), phase shifts, shortened closed phase, and irregularities in open and closed phases of the third and fourth oscillation cycle.

Similar pattern was shown for the posterior portion of the glottis.
Figure 4-1. RE VF in abduction.

Figure 4-2. RE VF in adduction.

Figure 4-3. VSK in a patient with RE, *anterior segment* of the VF (OQ = 0.42).
Figure 4-4. VSK in a patient with RE, *middle* segment of the VF (OQ = 0.50).

Figure 4-5. VSK in a patient with RE, *posterior* segment of the VF (OQ = 0.63).

**VF cyst (VFC)**

LVS images for VFC are shown in Figures 5-1 and 5-2. VFC may be situated off the middle third of the left or the right VF. The values of OQ on the middle area were lower compared to the anterior and posterior segments of the VF (Figures 5-3, 5-4, and 5-5).

VSK showed a slight left-right asymmetry in amplitude and phase and shortened closed phase.

Slight left-right asymmetry in amplitude and phase and shortened closed phase were also characteristic for the middle and posterior segments (Figures 5-4 and 5-5).

Figure 5-1. VFC of the left VF in abduction.
**Figure 5-2.** VFC of the left VF in adduction.

**Figure 5-3.** VSK of VFC of the left VF, anterior segment of the VF (OQ = 0.73).

**Figure 5-4.** VSK in a patient with VFC of the left middle segment of the VF (OQ = 0.58).
Figure 5-5. VSK of VFC of the left VF, posterior segment of the VF (OQ = 0.78).

*Sulcus vocalis (SV)*

LVS images for SV are shown in Figures 6-1 and 6-2. SV is rare condition affecting VF mucosa. SV may be congenital or acquired. In the case presented here, SV was of a bilateral type and caused a spindle-shaped glottis configuration during phonation. Thus, higher value of OQ was observed at the middle segment of the VF compared to the anterior and posterior thirds (Figures 6-3, 6-4, and 6-5).

The anterior segment showed left-right asymmetry in amplitude and phase. Amplitude was reduced on both sides, but more on the left, as was also the phase shift. The absence of VF closure was noted.

Similarly, in the middle segment the left-right asymmetry of amplitude and phase, diminished amplitude on both sides, more on the left were observed. There were also apparent phase shift, irregular oscillations, and no closure of the glottis.

At the posterior location the left-right asymmetry, slightly reduced amplitude on the left compared to the right, phase shift, and no closure were found.

Figure 6-1. Bilateral SV VF in abduction.
Figure 6-2. Bilateral SV VF in adduction.

Figure 6-3. VSK in a patient with bilateral SV, anterior segment of the VF (OQ = 0.67).

Figure 6-4. VSK in a patient with bilateral SV, middle segment of the VF (OQ = 0.83).
Figure 6-5. VSK in a patient with bilateral SV, posterior segment of the VF (OQ = 0.74).

Conclusions

Despite its inherent shortcomings, VSK is a very useful tool in studying organic mucosal lesions of the VF. These observations are helpful in treatment planning and in a serial follow-up.

References