Acta Clin Croat 2024; 63:595-603
doi: 10.20471/acc.2024.63.03-04.18

Original Scientific Paper

EFFECT OF USING TOPICAL ANESTHETIC DURING HIGH-SPEED DIGITAL IMAGING ON PHONATION ASSESSED BY DIGITAL KYMOGRAPHY PARAMETERS

Mario Bilić, Juraj Slipac and Lana Kovač Bilić

Department of Otolaryngology, Head and Neck Surgery, Zagreb University Hospital Center, Zagreb, Croatia

SUMMARY – High-speed digital imaging (HSDI) is a contemporary method of the phonation process assessment. It records laryngeal images at a rate of up to 8000 frames *per* second. Digital kymography (DK) extracts high-speed images sampled at a single point along the vocal folds and enables objective quantification of the vocal fold movements. According to the literature, usage of topical anesthetic (TA) in oral cavity, oropharynx and laryngopharynx prior to examination, in order to reduce pain and discomfort level, is optional but the effect of using TA on the phonation process is not well investigated. The aim of this study was to investigate the effect of using TA during HSDI on DK parameters. We performed a prospective double-blind randomized controlled study on 58 healthy subjects. All subjects were examined on 2 consecutive days using TA and using saline solution (placebo) by the same experienced examiner. DK images, made on the middle of the vocal folds, were obtained from HSDI. Vocal folds were examined across glottal cycles and glottal width and period irregularities, left-right phase asymmetry, and the open, closed, opening and closing quotient were calculated. Our data showed that using TA during HSDI did not induce statistically significant changes of DK parameters in healthy subjects.

Keywords: *Topical anesthetic; High-speed digital imaging; Digital kymography*

Introduction

Phonation process assessment and voice characteristics assessment are multidimensional and can be done with vocal cord visualization techniques or with acoustic analysis of the voice and auditory perceptive evaluation of voice[1–3]. Visualization techniques include rigid transoral and flexible transnasal laryngoscopy with or without videostroboscopy (VS). At present, VS is the most widely used assessment tool for vocal fold vibration evaluation and it is considered gold standard in current clinical practice[4]. VS images are obtained by reconstructing images within different phases of different vocal cord cycle due to frequency difference between phonation frequency and source of light frequency. Therefore, images are perceived as consecutive images in the same period. Also, because of its dependence on stable phonation, VS is not suitable for unstable, brief and aperiodic phonation[5]. High-speed digital imaging (HSDI) is a contemporary method of the phonation process assessment. Modern HSDI devices can record laryngeal images

Correspondence to: *Juraj Slipac, MD*, Department of Otolaryngology and Head and Neck Surgery, Zagreb University Hospital Center, Kišpatićeva 12, HR-10000 Zagreb, Croatia
E-mail: jslipac@gmail.com

Received July 13, 2022, accepted October 20, 2022

at a rate of up to 8000 frames *per* second, and 4000 images *per* second is considered minimal frequency of image capturing for detail analysis of vocal fold movements. HSDI is performed transorally with rigid endoscope. In contrast to VS, HSDI is not dependent on phonation frequency of the subject and therefore provides many information about vocal fold vibration by capturing consecutive images of vocal fold movement in the same vocal fold cycle with a high frame rate and good spatial resolution[6]. Due to large data of HSDI (usually 8000 images of vocal fold movement), analysis is complicated and is usually done by visual-perceptive rating of the examiner, therefore is not objective and not suitable for detail analysis of subtle changes in the phonation process. To overcome these difficulties, numerous quantitative analysis methods (glottal area waveform, digital kymography, etc.) that are extracted with software processing from HSDI have been developed. Quantification of vibratory characteristics and patterns *via* these methods can facilitate clinical management of pathologic conditions through better detection, estimation of severity of vocal fold disorder, making of therapeutic plan, and assessment of therapeutic result[7]. Digital kymography (DK) is made through juxtaposition of single pixel line of the laryngeal images within the frames, with the use of software processing. DK allows raters to access symmetry over a number of cycles in one image but it restricts the image to one pixel line across the vocal folds. DK enables objective assessment of vocal cord mediolateral movement with temporal features at a given longitudinal level (usually mid-glottal level) and subsequent objective measurement of the time phases, the opening and closing phases, the initial and later phases of the vibratory cycle, and the amplitude of vocal folds[8].

Topical anesthesia (TA) can be used prior to laryngeal endoscopy to reduce pain and discomfort level during examination, improve ease of passage of the endoscope, and maximize the chance of obtaining adequate visualization of the vocal cords[9]. The impact of TA application prior to examination on reduction of pain and discomfort level is not definitely proven for regular rigid and flexible laryngoscopy and consequently also for a novel method such as HSDI, which differs from the above mentioned by the hot (xenon) source of light and open ventilation system at the tip of the laryngoscope[4]. It is also assumed that TA does not affect laryngeal examination or the quality of the patient's voice[1]. This assumption, however, is controversial and so far the impact of using TA during laryngoscopy on the phonation process and voice characteristics is not unambiguously explained with various voice assessment methods[10-12].

The objective of this study was to determine the effects of oral application of TA on the phonation process assessed by objective DK parameters. To the best of our knowledge, this is the first study that evaluated the effect of TA application on the phonation process with quantified vocal fold motion parameters.

Subjects and Methods

We conducted a double-blind randomized controlled study between January 2021 and January 2022 at the Department of Otolaryngology, Head and Neck Surgery, Zagreb University Hospital Center. The institutional Ethics Review Board reviewed and approved the study. Written consent was obtained from all study subjects. A total of 58 healthy subjects, 26 male and 32 female aged 30.8±6.3 years participated in this study. An otolaryngology resident was responsible for enrolment, randomization of subjects and administration of substances, while one blinded experienced otorhinolaryngologist with more than 5 years of experience was responsible for performing and evaluating all HSDI examinations. Each participant served as their own control in a way that everybody was examined on 2 consecutive days with the application of lidocaine spray (100 mg/mL) and using saline as placebo. The 24-hour interval was chosen because this time window is sufficiently long for medication effects to disappear, yet sufficiently brief to minimize the chances of phonotraumatic, hormonal, or health changes affecting the larynx between two examinations. A computerized random number generator (Research Randomizer, online) was used to randomize the subject order of examination. The random number generator generated a unique number for each subject, and if an even number was generated, first HSDI was done using TA, whereas odd numbers resulted in HSDI being done with placebo first. All subjects received both HSDI with the usage of TA and placebo.

There was no change to randomization after beginning of the trial. Randomization was concealed from study subjects and the examiner who performed HSDI. Both placebo and TA were applied on the structure of the oropharynx, including base of the tongue, posterior pharyngeal wall, and soft palate. HSDI was done 5 minutes after the application to allow TA to take maximal effect. Volunteers were recruited with flyers to local music colleges and voice clinics. Vocal expertise was not relevant to the study but professionally oriented voice users were targeted because of high motivation to undergo laryngeal examination and thus to volunteer for the study. Exclusion criteria were known or suspected allergy to any anesthesia, smoking, any kind of acute or chronic otorhinolaryngologic disease, and inability to tolerate HSDI without the application of TA. Satisfaction of inclusion and exclusion criteria was determined during a pre-examination interview and general otorhinolaryngological examination that preceded HSDI. Subjects were unaware of the study purpose. HSDI was performed transorally on the chair where the subjects were seated with their mouth open and tongue protruded, extended held by the examiner. A 90° angle rigid endoscope (Wolf 5562 HRES ENDOCAM with Wolf Auto LP 5132 Hlight as a source of light, Knittlingen, Germany) was positioned in the oral cavity so that the position of the lens was parallel to the vocal cords to avoid laryngeal image distortion. The image was in the center of the viewing field and the entire length of the glottis was necessary to be visualized. Once the entire length of vocal cords was visualized, the subject was asked to phonate /i/, like a sound at a comfortable pitch and loudness without raising tongue to avoid potential interference with the position of the scope. HSDI data and images were acquired at a rate of 4000 frames *per* second with spatial resolution of 256x256 pixels and intensity and fundamental frequency of subject's phonation were also recorded. The quality of HSDI images was determined and in case of inadequate visualization of the vocal cords or poor image quality, HSDI was repeated until a satisfactory quality was obtained. Using Wolf software of the image recording system, DK was made by a line in the medial section of the laryngeal image for the capture and juxtaposition of the vocal fold images over time at the midpoint level due to its larger vocal fold mobility characteristics (Fig. 1). We used a customized computational routine to quantify different phases of the vibratory cycle of the vocal folds. Quantification of duration of the closed, open, closing and opening phases of the glottal cycle, as well as duration of the complete cycle was done as the calculation of the closed, closing, open, opening, and speed quotients. Value of the closed quotient is defined as the duration of closure divided by the duration of the glottal cycle. Open quotient is defined as the duration of open phase of the cycle divided by the duration of the glottal cycle. Opening quotient is

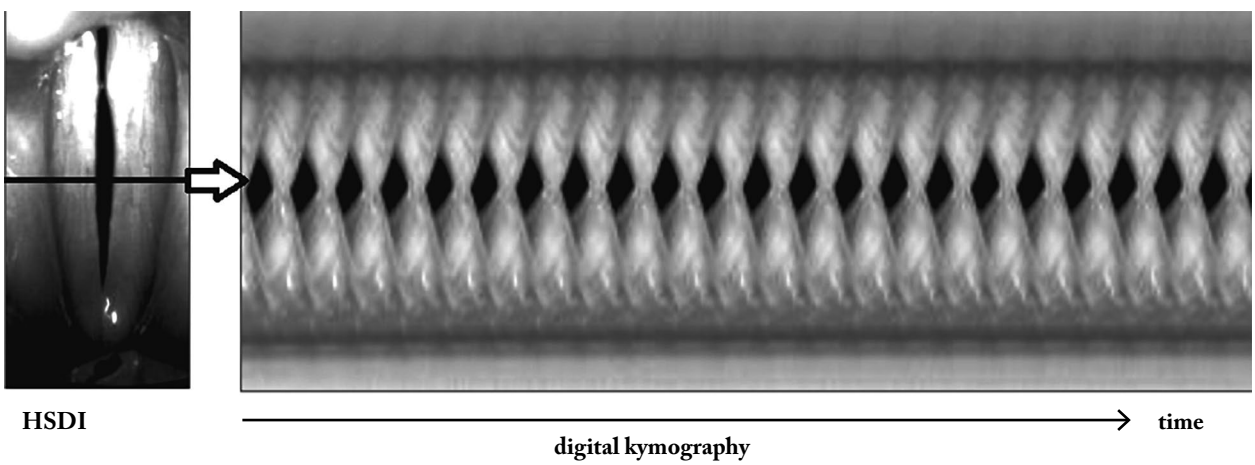

Fig. 1. Digital kymography made from high-speed recording at the mid glottal level by juxtapositioning single pixel line across high-speed digital imaging.

defined as the duration of the opening phase of glottal cycle (time from the end of the closed phase to the maximal lateral vocal fold position) divided by the duration of the glottal cycle. Closing quotient is defined as the duration of the closing phase of the glottal cycle (time from maximal lateral vocal fold position to the beginning of the closed phase) divided by the duration of the glottal cycle (Fig. 2). Speed quotient is the ratio between the duration of the opening and closing times of the vocal fold cycle[8].

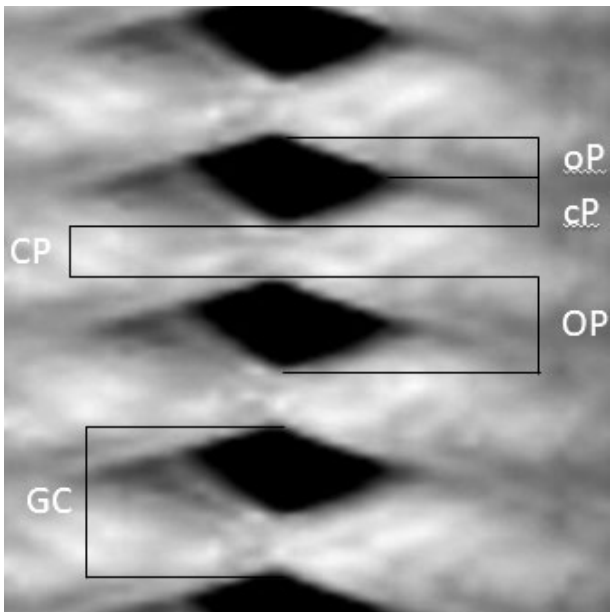

Fig. 2. Phases of glottal cycle on digital kymography.

OP = open phase; CP = closed phase; oP = opening phase; cF = closing phase; GC = glottal cycle

Left-right phase asymmetry was quantified from the DK static image. Vocal fold left-right relative phase asymmetry was measured over three cycles by taking time differentials between the onset of the closing phase for the right and left vocal folds and dividing the difference by the cycle periods (Fig. 3). The mean phase asymmetry of the three cycles was used to improve measurement precision[13]. Measures of glottal width and period irregularities were also made from the DK static image. Glottal width was measured at the middle of the open phase over five cycles of vibration. Glottal width irregularity was measured through

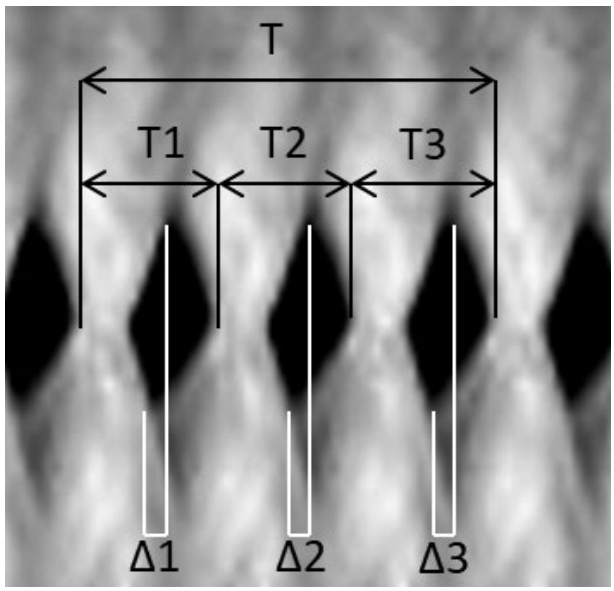

Fig. 3. Left-right phase asymmetry measured on digital kymography.

T1, T2, T3 = individual duration of 3 consecutive glottal cycles; T = total duration of 3 cycles; Δ1, Δ2, Δ3 = left-right phase asymmetry of 3 consecutive glottal cycles

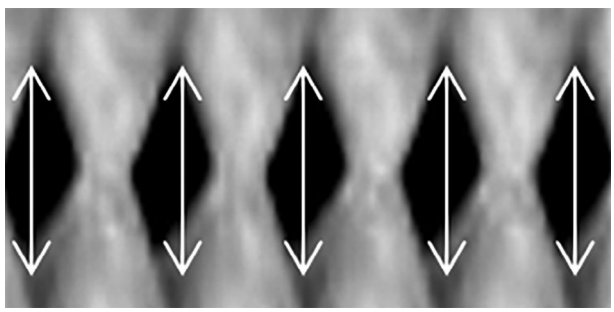

Fig. 4. Glottal width irregularity measured on digital kymography.

the maximum difference between consecutive cycles and calculated by dividing maximal difference with the mean glottal width (Fig. 4)[14]. Glottal period was measured from the beginning of one opening phase to the beginning of the subsequent opening phase over five cycles. Period irregularity was calculated by dividing

maximum difference between consecutive cycles and mean duration of cycles (Fig. 5)[14]. All quantitative measures were each taken twice to compensate for the possible human error because the measures were not automated.

Statistics

Statistical analysis was performed using a commercial software program (SPSS; IBM, Armonk, NY, USA). Descriptive measures were calculated. Paired t test was performed for normally distributed variables. If the variables were not normally distributed, which was determined with Kolmogorov-Smirnov test, the Wilcoxon test was used. The values of $p<0.05$ were considered statistically significant.

Results

Due to hyperactive gag reflex in 3 (5.1%) subjects, vocal cords were impossible to visualize with HSDI. In 2 (66%) of them, adequate visualization was obtained with the usage of TA. In another 2 (3.4%) subjects, the entire length of the vocal cord could not be visualized with and without the usage of TA. Data on these subjects were excluded from further analysis. In comparison with the usage of placebo, using TA prior to HSDI did not statistically significantly change the intensity and fundamental frequency of phonation ($p>0.05$ both). Median fundamental frequency was 152 (range 88-250) Hz with placebo and 186 (range 87-275) Hz with the usage of TA. Median phonation intensity was 89 dB (range 67-111) dB) with placebo and 90 (range 72-104) dB with the usage of TA. The results of statistical analysis of DK parameters and the impact of using TA on them are shown in Tables 1 and 2. There were no statistically significant differences, either with HSDI performed with the usage of TA or without it, in the following parameters: open quotient, closed quotient, opening quotient, closing quotient, and speed quotient. The usage of TA did not statistically significantly change the values of glottal width irregularity, glottal period irregularity, and left-right phase asymmetry on DK either.

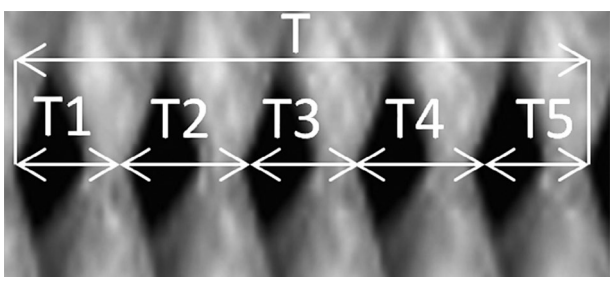

Fig. 5. Glottal period irregularity measured on digital kymography.

T = complete duration of 5 consecutive glottal cycles; T1, T2, T3, T4, T5 = individual duration of 5 glottal cycles

Discussion

To our knowledge, this was the first study to examine the effect of oral TA application prior to HSDI on the phonation process evaluated by DK objective parameters. We found that there were no statistically significant changes of DK parameters after the application of oral TA.

Topical anesthesia can be used prior to laryngeal endoscopy to relieve pain, improve ease of passage of the endoscope, and maximize the chance of obtaining adequate visualization of the vocal cords[1,9]. The optimal topical anesthesia regimen for transoral rigid laryngoscopy has not yet been established and the impact of applying TA on discomfort and pain level has not been unambiguously defined[15-17]. Also, when the anesthetic, after oral application, reaches the larynx and vocal cords, laryngeal sensation may be reduced affecting its proprioception. If this affects vocalization and/or swallowing functions, the examiner's interpretation of the examination might be affected as well[18,19]. Various studies with different voice characteristics and vocal fold movement analysis methods have been conducted to determine whether the usage of TA affects vocal fold movement patterns and voice characteristics. Lim *et al.* acoustically analyzed voice samples of healthy volunteers and found minimal differences in the parameters of voice characteristics (reduction of maximum frequency range) after the application of TA[20]. Yang *et al.* also found discrete changes of vocal characteristics in healthy subjects after TA application, evaluated by acoustic analysis of voice[10]. A study by Jacobs *et al.* showed that TA application prior to flexible

Table 1. Values of digital kymography parameters according to cycle phases with and without using topical anesthetic

	Not using TA		**Using TA**		
	M	SD	M	SD	p
OQ_	0.648859	0.107343	0.639054	0.101115	p>0.05
CQ_	0.350989	0.107531	0.360302	0.100996	p>0.05
oQ_	0.345132	0.070834	0.345197	0.065062	p>0.05
cQ_	0.303604	0.071794	0.345197	0.065062	p>0.05
SQ_	1.193697	0.352535	1.169292	0.337179	p>0.05

TA = topical anesthetic; M = mean; SD = standard deviation; OQ_= open quotient; CQ_= closed quotient; oQ_= opening quotient; cQ_= closing quotient; SQ_= speed quotient

Table 2. Values of digital kymography parameters according to vocal cord asymmetry with and without using topical anesthetic

	Not using TA		Using TA		
	M	SD	M	SD	p
GWI	0.035381	0.01663	0.035541	0.017316	p>0.05
GPI	0.034189	0.023078	0.034373	0.025608	p>0.05
PA	0.068902	0.053205	0.067094	0.050644	p>0.05

TA = topical anesthetic; M = mean; SD = standard deviation; GWI = glottal width irregularity; GPI = glottal period irregularity; PA = left-right phase asymmetry

transnasal laryngoscopy had no influence on voice characteristics in professional sopranos. The absence of changes of voice characteristics they attributed to excellent singing technique[11]. Rubin *et al*. studied the effect of TA application on vocal fold motion patterns and found that TA had no apparent effect on vocal fold motion[5]. Peppard and Bless compared VS finding with and without the application of TA prior to laryngoscopy and found that TA application had no statistical impact on VS parameters (mucosal wave amplitude and supraglottic activation)[9]. According to the results of the study conducted by Maxwell *et al*., vocalization is not affected by TA assessed by electrolarynography. However, mild dysarthria attributed to TA of the tongue and oropharynx was identified, as well as changes in the quality of voice restricted to higher frequency. The latter is explained by changes of laryngeal lubrication which affects vocal range. They also theorize that although vocalization and therefore fine motor control is unchanged in normal subjects after TA application, vocalization is largely under conscious control, and their subjects could hear their own voices, probably allowing some use of feedback and compensation, thus possibly disguising some fine motor effect[21]. A study by Rubin *et al*. showed that TA did not change gross vocal fold movement, and they suggest that TA applied most likely did not anesthetize deeper proprioceptive receptors of the larynx and did not change auditory feedback[22]. Hu *et al*. analyzed the impact of applying TA by acoustic analysis of the voice and VS, and found that the application of TA statistically significantly changed the values of fundamental frequency of phonation and *shimmer*, while the values of *jitter* and amplitude of mucosal wave were not changed[1]. Results of the study conducted by Lim *et al*. showed significant changes of minimal frequency of phonation, reduction of maximal phonation time, and increase of fundamental frequency after the application of TA[20]. Results of several studies also showed negative impact of TA application on swallowing assessed by

functional endoscopic evaluation of swallowing[23-25]. Several clinical reports show that TA can change the quantity or quality of laryngeal secretions, which can confound interpretation of laryngeal images and result in potential misdiagnosis[26]. Anesthesia-induced changes of characteristics of laryngeal secretion can also compromise the view of vocal cord, thus limiting diagnostic accuracy. Also, secretion balls can be mistaken for mass lesions of the vocal folds[26,27]. According to the results of the study conducted by Ayache *et al.*, change of viscosity of laryngeal secretion can lower vibratory frequency and prolong closed phase of the glottal cycle by generating superficial tension and causing adhesion, which results in nonlinearity of vocal fold vibration[28]. There are several potential criticisms of this study. Sample size was medium (58 subjects) and all subjects were healthy. Most of the subjects were vocal professionals who could compensate for the eventual impact of TA on the larynx with excellent phonation technique. Local sensory and auditory feedbacks are involved in laryngeal function and control, and auditory masking negatively affects intonation[22]. This effect is less marked in vocal professionals suggesting that kinesthetic feedback mechanisms are involved in controlling pitch and laryngeal function[29]. The usage of white noise during HSDI could perhaps annul feedback. Also, like other similar studies, we did not use real placebo in the sense of the same organoleptic features as the active substance. Instead, we used saline solution. In the literature, there is only one study that used real placebo, i.e., a pharmacy-prepared formulation consisting of water and the red dye amaranth, so that it had the same color, same consistency, and similar taste as lidocaine, but there was no preparation guidelines or expressed concentration of amaranth. On the other hand, duration of HSDI is very short (2 seconds) in comparison with VS or regular laryngoscopy, so there is a question whether there is enough time for the feedback to activate at all. There also are several novelties that this study brings. HSDI is a contemporary method of phonation process evaluation and calculated DK parameters are objective and quantified. Study design allowed subjects to act as their own controls because DK parameters of the subjects were compared with themselves before and after the application of TA. Also, subjects were blinded for the purpose of the study, while the examiner was blinded prior to examination whether TA or placebo was used. Cochrane systematic review concludes that there is no evidence to support the application TA prior to laryngeal endoscopy in order to reduce discomfort and pain level or increase visualization of the vocal cords[12]. However, as Burton *et al.* emphasize in their analysis that the fact that there is not sufficient evidence in the literature to confirm the value of TA application does not mean that TA does not have some value[30]. Using TA does not change the patterns of vocal fold motion, so we support its use when the clinician and/or patient feel that it is needed.

Conclusion

No clinically significant changes of vocal fold motion patterns were associated with the application of TA in healthy subjects. Clinicians can safely continue performing objective vocal fold measurement and accurate judgment of DK parameters after TA has been applied.

References

1. Hu A, Moore JE, Rose B, Fort S, Gracely EJ, Sataloff RT. The effect of oral topical anesthesia on the characteristics of voice. J Voice. 2014;28(1):92-7. doi: 10.1016/j.jvoice.2013.07.011
2. Toker K. Visualization of airway. Acta Clin Croat. 2016;55 Suppl 1:73-5. doi: 10.20471/acc.2016.55.s1.10
3. Bonetti A, Šimić I, Živković-Ivanović T. Voice outcomes as a result of voice therapy after lobectomy and thyroidectomy. Acta Clin Croat. 2020;59(Suppl 1):18-24. doi: 10.20471/ACC.2020.59.S1.02
4. Poburka BJ, Patel RR, Bless DM. Voice-vibratory assessment with laryngeal imaging (VALI) form: reliability of rating stroboscopy and high-speed videoendoscopy. J Voice. 2017;31(4):513.e1-513.e14. doi: 10.1016/j.jvoice.2016.12.003
5. Rubin AD, Shah A, Moyer CA, Johns MM. The effect of topical anesthesia on vocal fold motion. J Voice. 2009;23(1):128-31. doi: 10.1016/j.jvoice.2007.07.006
6. Yamauchi A, Imagawa H, Yokonishi H, *et al.* Evaluation of vocal fold vibration with an assessment form for high-speed digital imaging: comparative study between healthy young and elderly subjects. J Voice. 2012;26(6):742-50. doi: 10.1016/j.jvoice.2011.12.010

7. Yamauchi A, Imagawa H, Sakakibara K-I, *et al*. Characteristics of vocal fold vibrations in vocally healthy subjects: analysis with multi-line kymography. J Speech Lang Hear Res. 2014;57(2):S648. doi: 10.1044/2014_JSLHR-S-12-0269
8. Pimenta RA, Dájer ME, Hachiya A, Cordeiro GF, Tsuji DH, Montagnoli AN. High-speed kymography identifies the immediate effects of voiced vibration in healthy vocal folds. Int Arch Otorhinolaryngol. 2013;17(1):74-9. doi: 10.7162/S1809-97772013000100013
9. Peppard R, Bless M. The use of topical anaesthetic in videostroboscopic examination of the larynx. J Voice. 1991;5(1):57-63.
10. Yang CC, Chen SH. Impact of topical anesthesia on acoustic characteristics of voice during laryngeal telescopic examination. JAMA Otolaryngol Head Neck Surg. 2005;132(1):110-4. doi: 10.1016/j.otohns.2004.02.057
11. Jacobs MA, Kenny DT. Effects of topical anesthetic and flexible fiberoptic laryngoscopy on professional sopranos. J Voice. 2005;19(4):645-64. doi: 10.1016/j.jvoice.2004.10.002
12. Sunkareneni VS, Jones SEM. Topical anaesthetic or vasoconstrictor preparations for flexible fibre-optic nasal pharyngoscopy and laryngoscopy (Review). Cochrane Database Syst Rev. 2011 Mar 16;(3):CD005606. doi: 10.1002/14651858.CD005606.pub2.www.cochranelibrary.com
13. Bonilha HS, Deliyski DD, Whiteside JP, Gerlach TT. Vocal fold phase asymmetries in patients with voice disorders: a study across visualization techniques. Am J Speech-Lang Pathol. 2012;21(1):3-15. doi: 10.1044/1058-0360(2011/09-0086)
14. Bonilha HS, Deliyski DD. Period and glottal width irregularities in vocally normal speakers. J Voice. 2008;22(6):699-708. doi: 10.1016/j.jvoice.2007.03.002
15. Zhu ZH, Zheng J, Ying LY, Zhu BW, Qian J, Ma ZX. Cross-over study of topical anaesthesia with tetracaine solution for transoral rigid laryngoscopy. J Laryngol Otol. 2012;126(11):1150-4. doi: 10.1017/S002221511200182X
16. Jonas NE, Visser MF, Oomen A, Albertyn R, van Dijk M, Prescott CAJ. Is topical local anaesthesia necessary when performing paediatric flexible nasendoscopy? A double-blind randomized controlled trial. Int J Pediatr Otorhinolaryngol. 2007;71(11):1687-92. doi: 10.1016/j.ijporl.2007.07.001
17. Cain AJ, Murray DP, McClymont LG. The use of topical nasal anaesthesia before flexible nasendoscopy: a double-blind, randomized controlled trial comparing cophenylcaine with placebo. Clin Otolaryngol Allied Sci. 2002;27(6):485-8. doi: 10.1046/j.1365-2273.2002.00608.x
18. McCulloch TM, Richardson MA, Flint PW, Bishop MJ. Lidocaine effects on the laryngeal chemoreflex, mechanoreflex, and afferent electrical stimulation reflex. Ann Otol Rhinol Laryngol. 1992;101(7):583-9. doi: 10.1177/000348949210100707
19. Yanagisawa E, Yanagisawa K, Yanagisawa E. Stroboscopic videolaryngoscopy: a comparison of fiberscopic and telescopic documentation. Ann Otol Rhinol Laryngol. 1993;102(4):255-65. doi: 10.1177/000348949310200403
20. Lim VPC, Oates JM, Phyland DJ, Campbell MJ. Effects of laryngeal endoscopy on the vocal performance of young adult females with normal voices. J Voice. 1998;12(1):68-77. doi: 10.1016/S0892-1997(98)80076-3
21. Maxwell MJ, English JD, Moppett IK, McGlashan JA, Norris AM. Vocalization assessed by electrolaryngography is unaffected by topical lidocaine anesthesia. Anesth Analg. 2012;114(4):785-90. doi: 10.1213/ANE.0b013e3182455b71
22. Rubin AD, Shah A, Moyer CA, Johns MM. The effect of topical anesthesia on vocal fold motion. J Voice. 2009;23(1):128-31. doi: 10.1016/J.JVOICE.2007.07.006
23. Kamarunas EE, McCullough GH, Guidry TJ, Mennemeier M, Schluterman K. Effects of topical nasal anesthetic on fiberoptic endoscopic examination of swallowing with sensory testing (FEESST). Dysphagia. 2014;29(1):33-43. doi: 10.1007/s00455-013-9473-x
24. Fife TA, Butler SG, Langmore SE, *et al*. Use of topical nasal anesthesia during flexible endoscopic evaluation of swallowing in dysphagic patients. Ann Otol Rhinol Laryngol. 2015;124(3):206-11. doi: 10.1177/0003489414550153
25. Lester S, Langmore SE, Lintzenich CR, *et al*. The effects of topical anesthetic on swallowing during nasoendoscopy. Laryngoscope. 2013;123(7):1704-8. doi: 10.1002/lary.23899
26. Walsh J, Branski RC, Verdolini K. Double-blind study on the effects of topical anesthesia on laryngeal secretions. J Voice. 2006;20(2):282-90. doi: 10.1016/j.jvoice.2005.03.009
27. Bonilha HS, Aikman A, Hines K, Deliyski DD. Vocal fold mucus aggregation in vocally normal speakers. Logop Phoniatr Vocol. 2008;33(3):136-42. doi: 10.1080/14015430701875588
28. Ayache S, Ouaknine M, Dejonkere P, Prindere P, Giovanni A. Experimental study of the effects of surface mucus viscosity on the glottic cycle. J Voice. 2004;18(1):107-15. doi: 10.1016/j.jvoice.2003.07.004
29. Mürbe D, Pabst F, Hofmann G, Sundberg J. Significance of auditory and kinesthetic feedback to singers' pitch control. J Voice. 2002;16(1):44-51. doi: 10.1016/S0892-1997(02)00071-1
30. Burton MJ, Altman KW, Rosenfeld RM. Extracts from The Cochrane Library: Topical anaesthetic or vasoconstrictor preparations for flexible fibre-optic nasal pharyngoscopy and laryngoscopy. Otolaryngol Head Neck Surg. 2012;146(5):694-7. doi: 10.1177/0194599812444060

Sažetak

UTJECAJ PRIMJENE TOPIKALNE ANESTEZIJE NA PARAMETRE DIGITALNOG KIMOGRAMA FONACIJE PRI LARINGOSKOPIJI ULTRABRZOM KAMEROM

M. Bilić, J. Slipac i *L. Kovač Bilić*

Laringoskopija ultrabrzom kamerom (LUK) najsuvremenija je metoda analize procesa fonacije. Metoda omogućava snimanje fotografija glasnica tijekom fonacije frekvencijom do 8000 Hz. Digitalni kimogram (DK) nastaje jukstapozicijom jedne linije piksela iz snimke LUK-a te omogućava mjerenje i objektivizaciju nalaza LUK-a. Topikalna anestezija (TA) se pri LUK-u primjenjuje u usnoj šupljini, ždrijelu i grkljanu s ciljem smanjenja razina boli i neugode, no potencijalni alterirajući učinak primjene TA na process fonacije nije još dovoljno istražen, a rezultati dosad provedenih studija su proturječni. Cilj studije bio je utvrditi učinak primjene TA pri LUK-u na parametre DK-a. Prospektivna dvostruko slijepa randomizirana studija provedena je na 58 zdravih ispitanika. Svim ispitanicima LUK je učinjen u 2 uzastopna dana, pričem je TA i fiziološku otopinu kao placebo primijenio isti iskusni ispitivač. DK je izrađen na sredini duljine glasnica. Mjereni i izračunati su sljedeći parametri DK-a: varijacije glotisne širine i periodičnosti, fazna asimetrija lijeve i desne glasnice, otvoreni i zatvoreni kvocijenti te kvocijenti otvaranja i zatvaranja. Rezultati pokazuju da primjena TA pri LUK-u ne mijenja stastistički značajno vrijednosti parametara DK-a te ne utječe na process fonacije.

Ključne riječi: *Laringoskopija ultrabrzom kamerom; Topikalna anestezija; Digitalni kimogram*