

Laryngostroboscopic findings in postmenopausal women

P.T. Okasaki¹, G.P. Korn², J.C. Neto², N.A. de Brito Melo³, R.B. Cahali¹, E. Araujo Júnior⁴, F.A. Suzuki¹

¹Otorhinolaryngology Service, Institute of Medical Assistance to the State Public Servant of São Paulo (IAMSPE), São Paulo

²Department of Otorhinolaryngology and Head and Neck Surgery, Paulista School of Medicine - Federal University of São Paulo (EPM-UNIFESP), São Paulo

³Department of Gynecology and Obstetrics, Federal University of Piauí (UFPI), Parnaíba

⁴Department of Obstetrics, Paulista School of Medicine - Federal University of São Paulo (EPM-UNIFESP), São Paulo (Brazil)

Summary

Purpose of investigation: To describe the most frequent laryngostroboscopic findings in postmenopausal women. **Materials and Methods:** A prospective cross-sectional study was performed in postmenopausal women. The subjects were divided into two groups according to the presence or absence of changes in their voice pattern. All the subjects underwent a videolaryngostroboscopy examination. Stroboscopy parameters, presence of edema, and other findings were assessed. The groups were compared using the chi-square and Fisher's exact tests. **Results:** In total, 92 women were selected, 25 of whom reported changes in their voice pattern, 25 did not report any changes, and 42 were excluded. When comparing the groups with and without changes in their voice pattern, a significant difference was found only in the thyroid-stimulating hormone levels (1.88 ± 0.86 vs. 2.55 ± 1.06 , respectively; $p = 0.023$). No significant differences were observed in any of the stroboscopy parameters, such as the presence of edema and other findings. **Conclusion:** Laryngoscopic findings in postmenopausal women are independent of changes in the voice pattern.

Key words: Laryngoscopy; Postmenopausal; Dysphonia.

Introduction

The aging population is a global phenomenon - a trend that will always continue. Therefore, caring for the elderly population's health and quality of life has become the goal of many healthcare policies [1].

At approximately 50 years of age, women enter a transition period, in which they go from menarche to senescence. This period, known as perimenopause, is characterized by menstrual irregularity, vasomotor symptoms, sleep disorders, urogenital symptoms, loss of bone mineral density (osteoporosis), and a greater risk of cardiovascular diseases.[1]

It has been reported that the larynx can be a target for hormonal changes during menopause, which can manifest as a change in the voice pattern or dysphonia [2]. This could be explained by the presence of sexual hormone receptors in the larynx [3-5]. The term "dysphonia" refers to any difficulty and change in vocal emission that prevents natural voice production due to behavioral or structural factors [6].

In the postmenopausal period, mainly in obese women, the peripheral adipose tissue converts androstenedione, produced by the adrenal glands and the ovaries, into estrone, which is a weak estrogen with only one-third of the potency of estradiol [7]. This could lead to less evident voice changes in postmenopausal obese women [8].

Few articles in literature assess the impact of the postmenopausal period on the larynx and on vocal quality, par-

ticularly studies describing laryngostroboscopic findings [9-11].

This study aimed to describe the most frequent laryngostroboscopic findings in postmenopausal women and compare such findings between groups of women who did or did not report voice changes in the postmenopausal period.

Materials and Methods

This was a cross-sectional, prospective, observational study, comprising 50 women in the postmenopausal period, that is, those who had been in amenorrhea for at least 12 months. This study was approved by the Local Ethics Committee (approval number 034/11), and the women who agreed to voluntarily participate signed an informed consent form.

The women were randomly selected at the otolaryngology outpatient clinic of a third-level hospital. Exclusion criteria were as follows: previous and/or current hormone therapy, history of previous oophorectomy, history of previous irradiation of the pelvis, rheumatological diseases, neurological diseases, pulmonary diseases, hearing complaints or hearing loss, previous or current smoking, aged ≥ 70 years, routine use of inhaler medication, history of larynx surgery, dysphonia diagnosed before menopause, history of regular alcoholism, body mass index (BMI) of > 30 kg/m², thyroid-stimulating hormone (TSH) level of < 0.4 μ UI/ml or ≥ 4.5 μ UI/ml, follicle-stimulating hormone (FSH) level of < 30.0 UI/l, and women who were unable to be examined by rigid-optic videolaryngostroboscopy.

The selected women were divided into two groups according

Revised manuscript accepted for publication June 27, 2018

Table 1. — Stroboscopic evaluations of periodicity, symmetry, amplitude, mucosal wave, glottal closure, and movement of the vestibular, and arytenoid folds (cricoaarytenoid joint) in groups A and B and in the total sample (n).

	Group A [n (%)]	Group B [n (%)]	Total [n (%)]	p
Periodicity				
Normal (regular)	16 (64.0)	16 (64.0)	32 (64.0)	1.00 ^a
Changed	9 (36.0)	9 (36.0)	18 (36.0)	
Sometimes irregular	6 (66.7)	6 (66.7)	12 (66.7)	
Almost always irregular	2 (22.2)	2 (22.2)	4 (22.2)	
Always irregular	1 (11.1)	1 (11.1)	2 (11.1)	
Symmetry				
Normal (regular)	15 (60.0)	12 (48.0)	27 (54.0)	0.570 ^a
Changed	10 (40.0)	13 (52.0)	23 (46.0)	
Sometimes irregular	2 (20.0)	5 (38.5)	7 (30.4)	
Almost always irregular	1 (10.0)	1 (7.7)	2 (8.7)	
Always irregular	7 (70.0)	7 (53.8)	14 (60.9)	
Amplitude				
Normal	14 (56.0)	12 (48.0)	26 (52.0)	0.777 ^a
Changed	11 (44.0)	13 (52.0)	24 (48.0)	
Slight reduction	9 (81.8)	9 (69.2)	18 (75.0)	
Moderate reduction	2 (18.2)	3 (23.1)	5 (20.8)	
Severe reduction	0 (0)	1 (7.7)	1 (4.2)	
No visible change	0 (0)	0 (0)	0 (0)	
Mucosal wave				
Normal	13 (52.0)	11 (44.0)	24 (48.0)	0.777 ^a
Changed	12 (48.0)	14 (56.0)	26 (52.0)	
Slight reduction	11 (91.7)	9 (64.3)	20 (76.9)	
Moderate reduction	1 (8.3)	5 (35.7)	6 (23.1)	
Severe reduction	0 (0)	0 (0)	0 (0)	
Absent	0 (0)	0 (0)	0 (0)	
Glottal closure				
Normal (complete)	16 (64.0)	11 (44.0)	27 (54.0)	0.256 ^a
Changed 9 (36.0)	14 (56.0)	23 (46.0)		
Anterior chink	3 (33.3)	12 (85.7)	15 (65.2)	
Posterior chink	6 (66.7)	1 (7.15)	7 (30.4)	
Irregular chink	0 (0)	0 (0)	0 (0)	
Spindle chink	0 (0)	1 (7.15)	1 (4.4)	
Hourglass chink	0 (0)	0 (0)	0 (0)	
Incomplete	0 (0)	0 (0)	0 (0)	
Movement of vestibular folds				
Normal and symmetric	8 (32.0)	10 (40.0)	18 (36.0)	0.768 ^a
Changed	17 (68.0)	15 (60.0)	32 (64.0)	
Slight constriction	10 (58.8)	8 (53.3)	18 (56.3)	
Moderate constriction	6 (35.3)	7 (46.7)	13 (40.6)	
Complete constriction	1 (5.9)	0 (0)	1 (3.1)	
Arytenoid motion (cricoaarytenoid joint)				
Normal and symmetric	24 (96.0)	20.0 (80.0)	44 (88.0)	0.192 ^a
Diminished	1 (4.0)	5 (20.0)	6 (12.0)	
Average	0 (0)	5 (100)	5 (83.3)	0.167 ^b
Poor	1 (100)	0 (0)	1 (16.7)	

a = chi-square test; b = Fisher's exact test.

to the presence or absence of changes in their voice pattern. This was done through subjective questioning: "Has your voice changed? Has it become different compared to when you had regular menses?"

All the subjects underwent a videolaryngostroboscopy examination. First, the fundamental frequency (F0) was assessed using a sustained "E" vocalization. Then, the oropharynx was anesthetized with 10% lidocaine and a dynamic video was recorded. The examinations were performed by a single physician, with an Otolaryngology Specialist Certification from the Brazilian Oto-

laryngology and Cervicofacial Surgery Association (ABORL-CCF) and the Brazilian Medical Association (AMB). These examinations were further analyzed by two other laryngologists, with at least ten years of experience in laryngology and certified by ABORL-CCF and AMB. Interobserver evaluations were conducted without the examiners having access to each other's evaluations. Moreover, they were unaware of the group to which each woman belonged. If there was any interobserver variation, a third laryngologist with the same qualifications performed the evaluation.

Table 2. — Findings of edema in the vocal folds, edema in the free edges, and edema in the Reinke's space in groups A and B and in the total sample (n).

	Group A [n (%)]	Group B [n (%)]	Total [n (%)]	p
Presence of edema in the vocal folds				
No	14 (56.0)	14 (56.0)	28 (56.0)	1.000 ^a
Yes	11 (44.0)	11 (44.0)	22 (44.0)	
Presence of edema in the free edges of the vocal folds				
No	17 (68.0)	17 (68.0)	34 (68.0)	1.000 ^a
Yes	8 (32.0)	8 (32.0)	16 (32.0)	
Presence of edema in the Reinke's space				
No	12 (48.0)	17 (68.0)	29 (58.0)	0.252 ^a
Yes	13 (52.0)	8 (32.0)	21 (42.0)	

a = chi-square test.

Table 3. — Findings of muscular atrophy of the vocal folds, thinning of the vocal folds, changes in color of the vocal folds, presence of microvaricose veins in the vocal folds, and signs of laryngopharyngeal reflux in groups A and B and in the total sample (n).

	Group A [n (%)]	Group B [n (%)]	Total [n (%)]	p
Muscular atrophy of the vocal folds				
Absent	20 (80.0)	18 (72.0)	38 (76.0)	0.681 ^a
Present	5 (20.0)	7 (28.0)	12 (24.0)	
Unilateral	1 (20.0)	1 (14.3)	2 (16.7)	1.000 ^b
Bilateral	4 (80.0)	6 (85.7)	10 (83.3)	
Thinning of the vocal folds				
Absent	19 (76.0)	15 (60.0)	34 (68.0)	0.363 ^a
Present	6 (24.0)	10 (40.0)	16 (32.0)	
Unilateral	2 (33.3)	2 (20.0)	4 (25.0)	0.489 ^b
Bilateral	4 (66.7)	8 (80.0)	12 (75.0)	
Changes in coloration of the vocal folds				
No (pearly-white)	16 (64.0)	15 (60.0)	31 (62.0)	1.000 ^a
Yes	9 (36.0)	10 (40.0)	19 (38.0)	
Reddish	3 (33.3)	0 (0)	3 (15.8)	
Yellowish	4 (44.5)	4 (40.0)	8 (42.1)	
Bluish	0 (0)	0 (0)	0 (0)	
Opaque	2 (22.2)	6 (60.0)	8 (42.1)	
Presence of microvaricose veins in the vocal folds				
No	4 (16.0)	3 (12.0)	7 (14.0)	1.000 ^a
Yes	21 (84.0)	22 (88.0)	43 (86.0)	
Signs suggesting laryngopharyngeal reflux				
No	1 (4.0)	7 (28.0)	8 (16.0)	0.054 ^a
Yes	24 (96.0)	18 (72.0)	42 (84.0)	

a = chi-square test; b = Fisher's exact test.

The following parameters were assessed in the stroboscopy examination: periodicity, symmetry, amplitude, mucosal wave, glottal closure, vestibular fold motion, and arytenoid cartilage motion. Edema in the vocal chords, edema in the free edge of the vocal folds, and edema in the subepithelial space (Reinke's space) were also assessed. Other findings, such as muscular atrophy of the vocal folds, thinning of the vocal folds, changes in the coloration of the vocal folds, presence of microvaricose veins in the vocal folds, and presence of signs suggesting laryngopharyngeal reflux, were evaluated.

The data were transferred to an Excel 2007 spreadsheet and analyzed with SPSS version 19.0 software. A descriptive analysis of the groups was performed (total and groups A and B). Continuous variables were expressed as mean, median, and standard deviation. The Mann-Whitney test was used for comparison. The stroboscopic evaluations, the presence of edema, and other findings were tabulated and described as absolute and relative values.

For such variables, the chi-square test and Fisher's exact test were used to compare the two groups. A statistical significance level of $p < 0.05$ was established for all analyses.

Results

Laryngostroboscopy was performed in 92 postmenopausal women, 25 of whom reported changes in their voice pattern in the postmenopausal period and 25 of whom did not report any changes, giving a total of 50 women; 42 women were excluded: 12 were former smokers, two had chronic bronchitis and routinely used inhaler medication, 24 had BMI of >30 kg/m², two had TSH level of >4.5 μ UI/ml, and two were unable to undergo the examination with rigid optics because of an intense gag reflex.



Figure 1. — Image from a laryngostroboscopy examination showing the presence of microvaricose veins (arrow).

Among the women who reported changes in their voice pattern (group A) and those who did not (group B), there were no significant differences in age (55.80 ± 5.96 vs. 57.00 ± 7.04 years, respectively), period with amenorrhea (8.50 ± 6.45 vs. 8.65 ± 6.35 years, respectively), BMI (24.90 ± 1.95 vs. 24.61 ± 2.89 kg/m², respectively), and FSH levels (84.99 ± 32.32 ; 91.07 ± 36.27 mUI/ml, respectively). There was a statistically significant difference between groups only in terms of TSH levels (1.88 ± 0.86 vs. 2.55 ± 1.06 μ UI/ml, respectively; $p = 0.023$).

Regarding the stroboscopy findings, no statistically significant differences were observed between Groups A and B for any of the evaluated parameters (Table 1). In terms of the presence of edema, the most prevalent type of edema in group A was edema in the Reinke's space (52%), whereas in group B that change occurred in 32% of women, but with no statistically significant difference between the two groups (Table 2). In terms of the other findings, the authors observed that 43 (86%) women had microvaricose veins (Figure 1), and this was the most frequent laryngostroboscopic finding, followed by 42 (84%) women who had signs suggesting laryngopharyngeal reflux. No statistically significant differences were observed for the other findings between the two groups (Table 3).

Discussion

A reduction in the fundamental frequency of speech, particularly in women who do not undergo hormone replacement therapy (HRT), is common in postmenopausal women. This could be explained by a reduction in estrogens during that period [12]. D'haeseleer *et al.* [8] studied three groups of women (premenopausal and postmenopausal with and without HRT) and correlated the fundamental frequency of speech with BMI in each of those

groups. The authors concluded that in the non-HRT postmenopausal group, a greater BMI was associated with an increase in the fundamental frequency of speech, whereas no such association was found in the other groups. This could be explained by a higher estrogen production in the adipose tissue [8]. This fact was the basis for us to exclude women with a BMI of >30 kg/m² from the present study.

Hormonal dysfunctions of the thyroid gland, such as hypothyroidism, can lead to hoarseness, vocal fatigue, and edema of the vocal folds due to a deposition of mucopolysaccharide acids (myxedema). Hyperthyroidism can cause vocal fatigue and fundamental frequency instability [13]. Although groups A and B showed statistically significant differences only for the TSH level in this study, this was not found to be relevant because all women had TSH levels between 0.4 and 4.5 μ UI/ml [14].

Abitbol *et al.* [9] observed that the movement of the cricoarytenoid joint was diminished in postmenopausal women aged > 65 years. When D'haeseller *et al.* [11] evaluated postmenopausal women, they excluded women aged ≥ 70 years. In the present study, the authors also chose to exclude women aged ≥ 70 years.

Only three previous studies have evaluated postmenopausal women using laryngostroboscopy [9-11]. The first was conducted by Abitbol *et al.* [9], in which the authors described a menopausal vocal syndrome, characterized by the following symptoms: diminished vocal intensity, vocal fatigue, and reduced range with loss of high notes and of the timbre in both speaking and singing voice. They conducted an observational and subjective study evaluating 100 postmenopausal women who had not previously undergone HRT. Their sample included non-smoking women, but the authors did not take into account the subjects' age, BMI, and profession. Findings such as muscular atrophy, thinning of the vocal folds with reduced amplitude and phase asymmetry during stroboscopy, loss of the pearly-white color of the vocal folds, presence of microvaricose veins, and reduced mobility of the cricoarytenoid joint were only observed in women with dysphonia complaints. In the present study, the authors observed the same changes, but they were found in women both with and without dysphonia complaints, with no statistically significant difference between the groups.

Schneider *et al.* [10] conducted a study similar to this one, but they only evaluated 24 postmenopausal women with and without dysphonia complaints. They did not exclude women undergoing HRT, smokers, or regular alcohol drinkers. Edema in the vocal folds, edema in the free edges, and edema in the Reinke's space were observed in the group with dysphonia complaints. In the group without dysphonia complaints, only one woman had edema in the Reinke's space. Regarding glottal closure, there was no statistically significant difference between the groups. These kinds of edema were observed in the present study but with a higher frequency and in both groups. This fact could be

explained by the present larger sample, in addition to the finding of edema in the vocal folds, particularly in the Reinke's space, in the postmenopausal period, which has already been described in the literature [15]. Brunings *et al.* [5] found estrogen and progesterone receptors only in the vocal folds of women who had edema and laryngocele, thereby associating a greater sensitivity of vocal folds affected by edema to the estrogen and progesterone variations, which are typical during the postmenopausal period.

D'haeseller *et al.* [11] evaluated 34 premenopausal and 38 postmenopausal women according to both objective and subjective parameters. The authors did not find any statistically significant difference between the groups; however, when stroboscopy findings in postmenopausal women were separately considered, the most frequent change was incomplete glottal closure in 76.9% of the women. In the present study, the authors observed that 46% of the women showed the same change. This difference in findings could be explained by the use of a stroboscopic evaluation protocol that was different from the one adopted in the present study. D'haeseller *et al.* [11] used Remacle's stroboscopy evaluation protocol; moreover, the authors themselves performed and evaluated the stroboscopy examinations.

Because of the difficulty in defining normal voice and dysphonia and in evaluating a woman's voice at the time of the questionnaire and laryngostroboscopic examination, we have merely questioned the participating women about any changes in their voice patterns. Thus, dividing the women into two groups had some limitations because many women were not voice professionals and possibly had difficulties answering whether their voices had changed in the postmenopausal period. Ryan *et al.* [16] found that the women who most frequently noticed changes in their vocal quality with hormonal variations were those who had vocal training and who were voice professionals, especially singers.

The present study aimed to check the occurrence of all laryngostroboscopic findings previously described by other authors [9-11]. When the present authors divided the women into two groups, with and without changes in their voice patterns in the postmenopausal period, they observed that the most frequent findings in the group with changes were signs suggesting laryngopharyngeal reflux, microvaricose veins in the vocal folds, changes in the motion of vestibular folds, and presence of edema in the Reinke's space, with no statistically significant difference compared to the group without voice pattern changes. Therefore, the present authors can infer that women without complaints of voice pattern changes in the postmenopausal period showed larynx changes similar to those of women with complaints.

Conclusion

The present study shows that larynx changes occur in the postmenopausal period, and the authors believe that new

studies that prospectively evaluate only women who are voice professionals in the pre- and postmenopausal periods may correlate such larynx changes with the impact on voice quality.

References

- [1] D'haeseleer E., Depypere H., Claeys S., Van Borsel J., Van Lierde K.: "The menopause and the female larynx, clinical aspects and therapeutic options: a literature review". *Maturitas*, 2009, 64, 27.
- [2] Boulet M.J., Oddens B.J.: "Female voice changes around and after the menopause—an initial investigation". *Maturitas*, 1996, 23, 15.
- [3] Newman S.R., Butler J., Hammond E.H., Gray S.D.: "Preliminary report on hormone receptors in the human vocal fold". *J Voice*, 2000, 14, 72.
- [4] Ferguson B.J., Hudson W.R., McCarty K.S. Jr.: "Sex steroid receptor distribution in the human larynx and laryngeal carcinoma". *Arch. Otolaryngol. Head Neck Surg.*, 1987, 113, 1311.
- [5] Brunings J.W., Schepens J.J., Peutz-Kootstra C.J., Kross K.W.: "The expression of estrogen and progesterone receptors in the human larynx". *J. Voice*, 2013, 27, 376.
- [6] Nemr K., Simões-Zenari M., Duarte J.M., Lobrigate K.E., Bagatini F.A.: "Dysphonia risk screening protocol". *Clinics (Sao Paulo)*, 2016, 71, 114.
- [7] Goss A.M., Darnell B.E., Brown M.A., Oster R.A., Gower B.A.: "Longitudinal associations of the endocrine environment on fat partitioning in postmenopausal women". *Obesity (Silver Spring)*, 2012, 20, 939.
- [8] D'haeseleer E., Depypere H., Claeys S., Van Lierde K.M.: "The relation between body mass index and speaking fundamental frequency in premenopausal and postmenopausal women". *Menopause*, 2011, 18, 754.
- [9] Abitbol J., Abitbol P., Abitbol B.: "Sex hormones and the female voice". *J. Voice*, 1999, 13, 424.
- [10] Schneider B., Van Trotsenburg M., Hanke G., Bigenzahn W., Huber J.: "Voice impairment and menopause". *Menopause*, 2004, 11, 151.
- [11] D'haeseleer E., Depypere H., Claeys S., Wuyts F.L., De Ley S., Van Lierde K.M.: "The impact of menopause on vocal quality". *Menopause*, 2011, 18, 267.
- [12] Lindholm P., Vilkman E., Raudaskoski T., Suvanto-Luukkonen E., Kauppila A.: "The effect of postmenopause and postmenopausal HRT on measured voice values and vocal symptoms". *Maturitas*, 1997, 28, 47.
- [13] Guillot M., Vital Durand D., Levrat R.: "Dysphonia disclosing hyperthyroidism. 2 cases". *J. Fr. Otorhinolaryngol. Audiophonol. Chir. Maxillofac.*, 1984, 33, 169.
- [14] Sgarbi J.A., Teixeira P.F., Maciel L.M., Mazeto G.M., Vaisman M., Montenegro Junior R.M., *et al.*: "The Brazilian consensus for the clinical approach and treatment of subclinical hypothyroidism in adults: recommendations of the thyroid Department of the Brazilian Society of Endocrinology and Metabolism". *Arq. Bras. Endocrinol. Metabol.*, 2013, 57, 166.
- [15] Sinard R.J.: "The aging voice: how to differentiate disease from normal changes". *Geriatrics*, 1998, 53, 76.
- [16] Ryan M., Kenny D.T.: "Perceived effects of the menstrual cycle on young female singers in the Western classical tradition". *J. Voice*, 2009, 23, 99.

Corresponding Author:

E. ARAUJO JÚNIOR, PHD

Rua Belchior de Azevedo, 156 apto. 111, Torre Vitória
CEP 05089-030

São Paulo-SP (Brazil)

e-mail: araujojred@terra.com.br