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Impact of Postoperative Voice Therapy on Voice Outcomes of PhonomicrosurgeryFor Vocal Fold Polyps

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Vocal fold polyps are common in the general population and may cause significant dysphonia which is usually corrected by phonomicrosurgery. Voicetherapy following phonomicrosurgerymay be an effective adjuvant treatment in patients with vocal fold polyps for improving the postoperative voice outcomes. The aim of this studywas evaluation of theefficacy of voice therapy after phonomicrosurgeryfor vocal fold polyps.This study included 40 patients with vocal fold polyps admitted to ENT department, Zagazig University Hospitals divided into two equal groups; group Aunderwentphonomicrosurgery with postoperative voice therapy and groupBunderwentphonomicrosurgery without postoperative voice therapy.Thepatients were then assessed preoperativeand 2 months postoperative to evaluate their clinical condition and voice parameters.The present study showed no significant difference between the studied groups in age, sex and clinical history.Therewas significant difference between the two studied groups postoperative in voice parameterswith more improvement on group (A) than group(B).Acoustic analysis and aerodynamic measurements post-intervention, showed statistically significant difference between the two studied groups regarding fundamental frequency(F0), Jitter, shimmer,harmonic to noise ratio(HNR)and maximum phonation time(MPT)(153.6±32.7 *Vs*180.6±40.4, 0.53±0.27 *Vs*1.12±0.37, 1.78±0.53*Vs*2.97±0.6, 25.8±3.1*Vs* 22.1±3.6 and 25.6±2.96 *Vs*23.2±3.1)respectively. Regarding dysphonia grade, there was statisticallysignificant difference post-intervention between both groups where 70% of group A had dysphonia grade 0 versus 55%ofgroupB haddysphoniagradeIIand 45%haddysphonia gradeI.Postoperative voice therapy following phonomicrosurgery was an effective adjuvant treatment in patients with vocal voldpolypsfor improving postoperative voice outcomes..

Keywords: Vocal fold polyps, Phonomicrosurgery, Dysphonia andVoice therapy.

INTRODUCTION

The vocal folds are part of the glottis which includes their maglottidis. Their outer edges are attached to muscle in the larynx while their inner edges, or margins, are free forming the opening called the rimaglottides. Above both sides of the glottis are the two vestibular folds or false vocal folds which have a small sac between them called the ventricle (Wadie et al. 2013). Vocalis muscle is in fact a portion of thyroary tenoid muscle (Mizuta, 2017). Normal vibratory function is dependent upon the complex interactions within the extracellular matrix. An understanding of the normal layered structure of the vocal folds is necessary for all phonosurgeons (Long,2019). Vocal fold polyps (VFP) are benign proliferative lesions that are usually located unilaterally at the free margin of the membranous part of the vocal fold (VF) (Sahin et al. 2018). They arethought to develop in the superficial lamina propria (SLP)as

a result of microtrauma and/or inflammatory/non-inflammatory irritation (johns, 2003). VFPs vary in size (pin-head to popcorn), form (sessile or small pedunculated, mono- or multilobulated), location (free margin, subglottic side), and color (translucent, opaque, hemorrhagic)(Nunes et al. 2013). VFPs worsen voice quality due to glottal insufficiency and disrupt optimal mucosal wave propagation (martins etal.,2011). Therefore, the most common complaints are hoarseness, roughness, or breathiness in the voice. The main causative factor for polyp formation is mechanical damage by either vocal over and misuse or strong coughing. Chronic/recurrent upper airway infections,smoking, allergy, and extra esophageal reflux are co-factors (Filhoetal,2013). VFP can adversely affect the individual's quality oflife and result in decreased labor productivity and increased health care expenses (Cohen, 2006). Phonomicrosurgery is the most common treatment of vocal fold polypsand became a new standard of care to remove pathology in these cases without scar formation (Kumar et al. 2003). Postoperative voice therapy following phonomicrosurgery may be an effective adjuvant treatment in patients with vocal fold polyps for improving the postoperative voice outcomes (Petrovic-Lazicet al.2015).Voice therapy has been divided into 2 categories, indirect and direct therapeutic techniques (Gartner-Schmidt et al. 2017). Thus, the aim of the current study was the evaluation of the impact of postoperative voice therapy on the voice outcomes of phonomicrosurgery for vocal fold polyps via the following parameters; Dysphonia grade index using GRBAS scale, acoustic analysis consisting of average Fundamental Frequency (F0), Jitter Percent (jitt %), shimmer percent (shim%), Harmonic to Noise Ratio (HNR) and aerodynamic analysis in the form of maximal phonation time (MPT).

MATERIALS AND METHODS

An interventional randomized controlled clinical study included 40 patients with vocal fold polyps selected from the outpatient clinic of ENT department, Zagazig University Hospitals divided into two equal groups; group (A)which included 20 patients underwent phonomicrosurgery with postoperative voice therapy and group (B) which included 20 patients underwent phonomicrosurgery without postoperativevoice therapy.

All patients were clinically diagnosed vocal fold polyp with age above 18 years old and fit for general anesthesia. No history of previous laryngeal operations or other laryngeal lesions. All cases were unilateral. All patients gave informed consent for inclusion in the study. The institutional review board of our institution approved the study protocol.

All studied patients were subjected to: (a) General history taking with stress on voice abuse and smoking and laryngopharyngeal reflux. (b) general ENT examination. (c) Video laryngostroboscopy. (d) Voice assessment via the following parameters: auditory perceptual assessment (APA) using GRBAS scale(G/grade,R/roughness,B/breathness,A/asthenia,S/strain). Acoustic analysis consisting of: F0, Jitter percent, shimmer percent, HNR and Aerodynamic measurement consisting of MPT.

Routine laboratory investigations were done for studied patients e.g. CBC, liver and kidney function tests, random blood sugar,coagulation profile and viral markers. Suspension laryngoscopy with phonomicrosurgery under general anesthesia was done for all patients using the microflap technique to preserve the vocal folds layered microstructure (including the lamina propria and epithelium) as much as possible .All surgeries were performed by the same surgeon (E.A.M.).

After surgery. All patients received routine medical treatment in the form of amoxicillin antibiotic, paracetamol for one week and anti-reflux therapy in the form of omeprazole 20mg orally twice daily and gaviscon advance suspension one tablespoonful 3 times daily for 8 weeks. Also, patients of both groups were instructed absolute voice rest forone week and voice hygienic measures then gradual increase in daily phonation time during the following 3 weeks. Group A patients received postoperative voice therapy which started one month after surgery(to allow complete healing of the vocal folds)by a trained phoniatrician. The main components of voice therapy program were educating patients on vocal hygiene, reduction of vocal abuse and hard glottal attack, breathing and posture exercises, resonance improvement and vocal function exercises. Voice therapy was carried out three times a week and delivered for four weeks. Group B patients did not receive voice therapy. Regular follow up for all patients was done for 2 months after surgery. After 2 months, re-evaluation of all the patients was done which included video laryngostroboscopy and voice parameters which were done preoperatively by the senior

phoniatrician (A.S.Q.) who was unaware of the treatment allocation.

Statistical analysis

Data were collected and analyzed using SPSS version 23 for data processing. The following statistical methods were used for analysis of results of the present study. Data were expressed as number and percentage for qualitative variables and mean + standard deviation (SD) for quantitative one. P value of< 0.05 indicates significant results and <0.001indicates highly significant results.

RESULTS

In the current study, The mean age of patients in group A was (39.1±10.5) ranging from (22 to 62) years, (60.0%) of them were males and that of group B was (39.5±9.6) ranging from (24to 60) years with (65.0%) of them were males with no statistically significant difference between the two studied groups regarding age, sex and occupation (Table1).

As well, there was no statistically significant difference between the two studied groups regarding disease onset, voice abuse, smoking and the affected side which affect the disease severity and outcome (Table 2).

Concerning acoustic analysis and aerodynamic measurements, there was no statistically significant difference between the two studied groups regarding pre-intervention F0, Jitter, shimmer, HNR and MPT (Table 3).Regarding dysphonia grade, there was no statistically significant difference between the studied groups pre-intervention (Table 4).

Regarding comparing acoustic analysis and aerodynamic measurement post-intervention among the studied groups of the present study there was statistically significant difference between the two studied groups regarding post-intervention F0, Jitter, shimmer, HNR and MPT t with more improvement on the group A than group B (153.6±32.7 versus180.6±40.4,0.53±0.27versus1.12±0.37, 1.78±0.53 versus 2.97±0.6, 25.8±3.1 versus 22.1±3.6 and25.6±2.96 versus 23.2±3.1) respectively (Table5).

The present results in (Table 6)showed the improvement on post- intervention dysphonia grade, there was statistically significant difference between the two studied groups with more improvement on the group (A) underwent surgery with voice therapy than group (B) surgery without voice therapy where (70.0%) of group A didn't have dysphonia while (55.0%) of B had dysphonia grade (II) and 45% had dysphonia gradeI.

Table (1): Socio-demographic characteristics between group (A) and group (B)

Variable	**Group (A)** *Surgery + voice therapy (n=20)*		**Group (B)** *Surgery without voice therapy (n=20)*		**Test**	**p-value**
Age (years) *mean ± SD* *(Range)* *median*	39.1±10.5 (22-62) 38		39.5±9.6 (24-60) 38.5		0.01	0.9
Variable	**Group (A)**		**Group (B)**		χ^2	**p-value**
	No(20)	**%**	**No(20)**	**%**		
Sex						
Male (25)	12	60.0%	13	65.0%	0.1	0.7
Female (15)	8	40.0%	7	35.0%		
Occupation						
Engineer(4)	2	10.0%	2	10.0%		
Teacher(8)	3	15.0%	5	25.0%		
Seller(10)	5	25.0%	5	25.0%		
Housewife(4)	2	10.0%	2	10.0%	4.6	0.6
Farmers(4)	2	10.0%	2	10.0%		
Others(10) (worker-employee-driver…etc.)	6	30.0%	4	20.0%		

Table 2:Clinical history between the two studied groups

Variables	Group (A) *Surgery + voice therapy (n=20)*		Group (B) *Surgery without voice therapy (n=20)*		Test	p-value
Disease onset (months) *mean ± SD (Range) median*	14.6±5.7 (6-24) 15		16.4±6.1 (7-28) 17		M.W= 0.9	0.3
Variables	**Surgery with voice therapy**		**Surgery without voice therapy**		χ^2	p-value
	No(20)	**%**	**No(20)**	**%**		
Voice abuse						
Yes (34)	18	66.7%	16	51.5%	FET	0.6
No (6)	2	33.3%	4	48.5%		
Smoking						
Yes (12)	6	30.0%	6	30.0%	0.0	1
No (28)	14	70.0%	14	70.0%		
Affected side						
Right (22)	11	55.0%	11	55.0%	0.0	1
Left (18)	9	45.0%	9	45.0%		

M.W= Mann-Witenney U test, FET=Fischer Exact test.

Table (3): Comparing acoustic analysis and aerodynamic measurement pre-intervention between the two studied groups

Acoustic analysis pre-intervention	Group (A) *Surgery + voice therapy (n=20)*	Group (B) *Surgery without voice therapy (n=20)*	Test	p-value
F0 *Normal= M:(100:190)Hz F:(180:260)Hz*	198.8±50.4 (125-356) 193.5	193.9±48.3 (124-341) 185	0.3	0.7
Jitter *Normal= (up to 1%)*	1.46±0.67 (0.26-2.73) 1.4	1.34±0.65 (0.27-2.71) 1.01	M.W=0.6	0.5
Shimmer *Normal= (up to 3%)*	3.39±0.96 (1.93-5.13) 3.06	3.2±0.85 (1.9-4.71) 3.08	0.9	0.3
HNR *Normal= (15:30)*	16.9±4.7 (7-22) 18.5	17.1±4.3 (8-22) 18	0.1	0.8
MPT *Normal= (20:30s)*	13.8±4.3 (7-19) 15	14.5±3.8 (8-18) 16.5	0.5	0.6

Table 4: Comparing dysphonia grade pre-intervention between the two studied groups

Dysphonia grade	Group (A) Surgery + voice therapy		Group (B) Surgery without voice therapy		χ^2	p-value
	No(20)	%	No(20)	%		
III	14	70.0%	8	40.0%	3.7	0.15
II	4	20.0%	9	45.0%		
I	2	10.0%	3	15.0%		

Table 5: Comparing acoustic analysis and aerodynamic measurement post-intervention

Acoustic analysis post-intervention	Group (A) Surgery + voice therapy (n=20)	Group (B) Surgery without voice therapy (n=20)	Test	p-value
F0 Normal= M:(100:190)Hz F:(180:260)Hz	153.6±32.7 (109-250) 156.5	180.6±40.4 (113-291) 176	2.3	**0.02***
Jitter Normal= (up to 1%	0.53±0.27 (0.09-0.92) 0.43	1.12±0.37 (0.18-1.61) 0.98	M.W= 5.7	**0.001****
Shimmer Normal= (up to 3%)	1.78±0.53 (0.63-2.91) 1.96	2.97±0.6 (1.61-3.21) 2.95	6.6	**0.001****
HNR Normal= (15:30)	25.8±3.1 (18-30) 26.5	22.1±3.6 (15-26) 22.5	3.4	**0.001****
MPT Normal= (20:30s)	25.6±2.96 (20-29) 27	23.2±3.1 (15-27) 2	2.7	**0.009***

M.W= Mann-Witenney U test, * Statistically significant difference (P ≤ 0. 05) and ** Statistically highly significant difference (P ≤ 0.001).

Table 6: Comparing dysphonia grade post-intervention between the two studied groups

Dysphonia grade	Surgery with voice therapy		Surgery without voice therapy		χ^2	p-value
	No(20)	%	No(20)	%		
0	14	70.0%	0.0	0.00%	23.5	**0.001****
I	5	25.0%	9	45.0%		
II	1	5.0%	11	55.0%		

DISCUSSION

Vocal fold polyps (VFPs) are benign lesions that develop secondary to vocal behavioral inefficiencies. These lesions can cause significant distress, decreased quality of life, and disability, especially for patients who use theirVoice in their occupation (Agarwaletal. 2019). Polyps of varied size are caused by submucosal bleeding of the vocal cords, in combination with infection, allergy, pollution or endocrine disorders, voice misuse, and smoking. The incompetent vocal fold adduction allows air to leak, causing an increase in noise in the vocal note, which is reflected in a reduced harmonic-to-noise ratio (Schindler et al. 2012; Petrovic-Lazicet al.2015). Several studies

evaluated therapy effect using perceptual analyses performed by trained voice specialist (Oğuz et al. 2011). However, there is no general agreement with regard to which method is most appropriate for evaluating the outcome of voice therapy and the phonosurgical procedure.

This prospective trial was conducted to evaluate the outcomes of postoperative voice therapy after phonomicrosurgry for vocal fold polyps. The study included 40 patients with vocal fold polyps selected from outpatient clinicof otorhinolaryngology department, Zagazig University Hospitals. Patients were divided into two equal groups, group (A) for phonomicrosurgery with postoperative voice therapy and group (B) for phonomicrosurgery without postoperative voicetherapy.

Our results showed no statistically significant difference between the two studied groups regarding age, sex and occupationas. This resultwas in agreement with Agarwal et al. (2019) who revealed in120 patients that there were63 (52.5%) were males and 57 (47.5%) were female, with an average age of 42.9 years. Also, inagreement with Oh et al. (2018) whose study included patients with vocal polyps and divided into three groups. Group 1 received direct voice therapy after phonomicrosurgery and Group 2recieved indirect voice therapy after phonomicrosurgery. Group 3 did not receive any voice therapy. There was no statistically significant difference between them regarding age and sex.

The current study showed that there was no statistically significant difference between the two studied groups regarding disease onset, voice abuse, smoking and the affected side which may affect the disease severity and outcome. This was in consistent with Petrovic-Lazic et al. (2015) who considered pollution, endocrine disorders, voice misuse, and smoking were risk factors for vocal fold polyps.

Regarding comparing acoustic analysis and aerodynamic measurement pre-intervention, there was no statistically significant difference between the two studied groups regarding F0, Jitter, shimmer, HNR and MPT. This was in agreement with Oh et al.(2018) whose findings showed no statistically significant difference between the studied groups, Jitter was (2.94±1.73 vs 3.27±1.66), shimmer was (7.36±4.04 vs 7.28±2.37), HNR (0.21±0.09 vs 0.21±0.26) and MPT was (10.57±4.33 vs10.66±4.04) on direct voice therapy after phonomicrosurgery group and phonomicrosurgery group only respectively. Acoustic analysis profile shows increase of Jitter and Shimmer measures because the polyp tends to lag behind the vocal fold vibration and has its own vibratory pattern, the successive vibrations of which are often aperiodic (Schindler etal.2012).

Moreover, the attainable results showed that, there was statistically significant difference between the two studied groups regarding post-intervention F0, Jitter, shimmer, HNR and MPT with more improvement on the group A than group B. This was consistent with You et al. (2017) Whose study included two groups; voice training with surgery and surgery only, the experimental group included 55 patients with vocal cord polyps that underwent voice training after phonomicrosurgery. In the control group, no voice training was performed for 41 patients after phonomicrosurgery. Thevoice handicap index(VHI)score and Jitter values recorded after the surgery were superior in the experimental group to those noted for the control group.

Concerning the improvement on post-intervention dysphonia grade, there was statistically significant difference with more improvement on the group (A) than group (B) where 70% of group A had dysphonia grade 0 while 55% of group B had dysphonia grade II and 45% had dysphonia grade I. Agarwal et al.(2019) performed retrospective study comparing the effect of surgery,surgery plus voice therapy and voice therapy in patients with VFP, VHI and GRBAS. They reported statistically significant improvement from pre to post treatment in the groups of surgery and surgery plus voice therapy compared to voice therapy group.Pre and post treatment GRBAS did not significantly change in any group on the short term(mean follow up period 5.5 months)

CONCLUSION

Postoperative voice therapy following phonomicrosurgery was an effective adjuvant treatment in patients with vocal fold polyps for improving postoperative voice outcomes. Acoustic, aerodynamic and perceptual voice parameters improved considerably after surgery with postoperative voice therapy more than surgery alone.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

All author contributed in all parts of the paper

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