Correlação entre voz e fala traqueoesofágica e pressão intraluminal da transição faringoesofágica******

Correlation between tracheoesophageal voice and speech and intraluminal pharyngoesophageal transition pressure

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Abstract
Background: rehabilitation of individuals with total laryngectomy. Aim: to correlate the voice and speech proficiency of individuals with total laryngectomy, users of tracheoesophageal, prosthesis with the intraluminal pharyngoesophageal transition pressure at rest and during phonation. Method: twelve individuals with total laryngectomy and with tracheoesophageal voice, users of speech prosthesis, were submitted to a voice and speech sample gathering and registration. These individuals were assessed by three experts using a specific protocol for the evaluation of tracheoesophageal communication. Individuals also underwent esophageal manometry in order to evaluate the intraluminal pharyngoesophageal transition pressure during rest and phonation. Results: during phonation, individuals who had been characterized by the experts as good speakers (16.7%) presented average values of pressure amplitude during pharyngoesophageal transition of 27.48mmHg. Average amplitude of 30.63mmHg was observed for individuals classified as moderate speakers (52.5%), and of 38.72mmHg for individuals classified as poor speakers (30.8%). During rest, the good speakers presented an average pressure of 14.72mmHg, the moderate speakers of 13.04mmHg and the poor speakers of 3.54mmHg. Conclusion: the good speakers presented the lowest amplitude values of pharyngoesophageal transition pressure during phonation. However, the pressure observed in the rest condition was higher for the good speakers and lower for the poor speakers, suggesting that the raise in the pharyngoesophageal transition pressure during phonation damages the quality of tracheoesophageal communication when using speech prosthesis.
Key Words: Laryngectomy; Manometry; Speech Alaryngeal.

Resumo
Tema: reabilitação do laringectomizado total. Objetivo: correlacionar a proficiência de voz e de fala de laringectomizados totais usuários de prótese traqueoesofágica com a pressão intraluminal da transição faringoesofágica no repouso e durante a fonação. Método: foram estudados 12 laringectomizados totais com voz traqueoesofágica, usuários de prótese fonatória, submetidos à coleta e registro do material de voz e da fala, que foram avaliados por três expertos, utilizando-se um protocolo de julgamento geral da comunicação traqueoesofágica. Em seguida, os indivíduos foram encaminhados à manometria esofágica para avaliar a pressão intraluminal da transição faringoesofágica durante a fonação e no repouso. Resultados: durante a fonação, os indivíduos caracterizados como bons falantes (16,7%) pelos expertos apresentaram valores médios de amplitude de pressão na transição faringoesofágica de 27,48mmHg. Entre os falantes moderados (52,5%), obteve-se amplitude média de 30,63mmHg e para os piores falantes (30,8%), 38,72mmHg. Durante o repouso, os melhores falantes apresentaram pressão média de 14,72mmHg, os moderados, 13,04mmHg e os piores falantes, 3,54mmHg. Conclusão: os melhores falantes apresentaram os menores valores de amplitude de pressão durante a fonação. Em contrapartida, a pressão em repouso foi maior para os bons falantes e menor para os piores, sugerindo que a elevação da pressão na transição faringoesofágica durante a fonação prejudica a qualidade da comunicação traqueoesofágica com a prótese fonatória.
Palavras-Chave: Laringectomia; Manometria; Voz Alaríngea.

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Introduction

Among the methods of communication available to total laryngectomees, the tracheoesophageal prosthesis (TEP) has been widely accepted, representing a convincing option of rehabilitation. Despite evident success rates1-4, there are also appreciable numbers of failures whose reasons have not been clearly defined5.

To elucidate the possible causes of failure of tracheoesophageal communication, many investigators6-12 have devoted themselves to the study of the morphophysiology of the pharyngoesophageal transition (PET). Objective and measurable methods of evaluation are used for this purpose, such as esophageal manometry, often associated with perceptive-auditory evaluation of tracheoesophageal voice, despite the wide morphophysiological variability among individuals and the lack of normative data for the characterization and prediction of voice and tracheoesophageal speech proficiency.

During alaryngeal phonation, PET tonicity represents important information for the the assessment of tracheoesophageal voice, influencing the efficacy and quality of the oral communication of total laryngectomized patients with a TEP13. However, despite the importance of PET and its repercussions on the quality of tracheoesophageal voice, few studies have used vocal tests for its evaluation10-11, 13-17, with the need for more information in order to define parameters that will permit a better characterization of TEP success or failure.

In order to contribute to this field of research, the objective of the present study was to correlate the voice and speech proficiency of total laryngectomized patients using a TEP with the intraluminal PET pressure at rest and during phonation.

Method

The study was approved by the Research Ethics Committee of the University Hospital, Faculty of Medicine of Ribeirão Preto, University of São Paulo (Protocol No. 11444/2007).

Twelve total laryngectomees, nine men and three women aged on average 64 ± 8.4 years, were evaluated. The patients were attended at the Division of Head and Neck Surgery of the University Hospital, Faculty of Medicine of Ribeirão Preto, University of São Paulo (HCFMRP-USP). All had been submitted to secondary puncture for the placement of a Provox® phonatory prosthesis (Atos Medical AB, Hörby, Sweden), with a mean time of TEP use of 4.6 ± 3.8 years. They had received 5 ± 1.7 sessions of speech therapy for the rehabilitation of communication with a TEP.

The sample was assembled by reviewing the medical records of 258 total laryngectomees operated upon between 1995 and 2008. Of these, we called only patients submitted to classical laryngectomy with closure of the mucosa, submucosa and musculature for the reconstruction of the pharynx, who were speakers with the secondary insertion of a TEP with digital occlusion, regardless of phonatory quality, type of cervical dissection or application of radiotherapy.

We excluded patients submitted to pharyngectomy, total laryngectomy associated with glossectomy or pelveglossectomy, laryngectomy with the use of flaps for reconstruction of the pharynx and preventive or curative treatments of spasms and pharyngeal hypertonicity, i.e., neurectomy of the pharyngeal plexus, cricopharyngeal myotomy, chemical denervation of the constrictor musculature of the pharynx, or pharynx reconstruction without closure of the muscle layer. Also excluded were patients with recurrence or metastases of laryngeal neoplasia at the time of the present study, with esophageal or gastrointestinal diseases, as well as patients with complaints of dysphagia, with reduced hearing acuity and/or with some type of cognitive impairment, based on oral questioning regarding each of these complaints, in association with data from their medical records.

Procedures

Assessment of voice and speech proficiency with a TEP

Individual recordings were performed in an acoustically treated room with noise below 50 dB (42.5 ± 3.2 dB) measured with a digital decibel meter Impac® IP-900DL data logger Type II calibrated with an Impac® ND9 calibrator and programmed at the automatic level. A 30-130 dB (slow) capture range was considered in real time mode, recorded on a PC computer equipped with an Intel® CoreTM 2 duo processor. Mean habitual environmental temperature was 26.6 ± 1.3°C and humidity was 42.2 ± 4.5%, recorded with a portable digital Impac® TH02 thermohygrometer in the out position.

Voice and speech were recorded with a digital Sony® handycam - DCR-SR85 movie camera adapted to a tripod. The individuals sat at a distance of one meter from the camera so that their sound

production could be recorded in a standardized manner. They were instructed to use their habitual voice and speech intensity, velocity, quality and frequency during the tests. The participants were asked to perform prolonged emission of the vowels "a", "i", "u", to count from one to 20, to sing "Happy birthday to you!" and to emit spontaneous speech in response to the question: "What are the advantages and disadvantages of using a voice prosthesis?"

Minimum, habitual and maximum voice intensities were measured on the basis of the sustained emission of the vowel "a" with the subject following the instructions of weak, habitual and strong emission. The emissions were captured every 0.2 s with the decibel meter located at a distance of one meter from the oral cavity of the participant and the final mean value was calculated according to maximum phonation time.

Dynamic extension was based on the maximum and minimum intensities recorded by the decibel meter. The maximum times of phonation of the vowels "a", "i", "u" were measured twice with a digital Timex Triathlon® chronometer, and the final mean value in seconds was calculated.

The protocol of Hilgers et al.18 was adapted for the qualification of voice and speech proficiency with a TEP. This protocol considers three global aspects of analysis (phonatory skills, additional aspects and general judgment) and the final judgment is obtained, which was the objective of the present study. Except for the quantitative parameters (maximum phonation time, dynamic extension and maximum identity), all other parameters were judged auditorily and/or visually by the experts. This judgment was based on the following steps: presentation of the objectives of the study and of the adapted protocol to the experts; training of the experts with a sample of ten videos of speakers with a TEP, and finally judgment of communication by the experts, performed during three meetings.

Twenty protocols adapted from Hilgers et al.18 were distributed to each expert at each meeting, together with a card containing the conceptual definition of the parameters evaluated. The videos were projected as a data show in a randomized manner, with the vocal intensity of the participants being adjusted to a comfortable level maintained for the entire file.

The experts were selected by the adaptation of a Specialist Scoring System (Table 1) applied to the model of Fehring19 modified by Jesus20. A minimum score of five points was established for the expert, whose qualification was determined on the basis of the Lattes Platform system (www.cnpq.br). On the basis of these requirements, three speech therapists with no hearing complaints were selected, whose scores were 14, 13 and 9, with a mean of 12 points. Each expert signed an informed consent form.

Manometry

After the voice and speech recording, the participants were submitted to manometry, which was performed by the same gastroenterologist and accompanied by a speech therapist in the Laboratory of Functional Gastroenterology Tests, Division of Gastroenterology, HCFMRP-USP.

The exam was performed using an eight-channel polyvinyl probe 4 mm in outer diameter and 0.8 mm in inner diameter in each channel (Memphis Biomedical®). The four proximal channels were separated by a distance of 5 cm and were connected to Dtp-6100 pressure transducer (PVB Medizintechnik Gmbh®, Germany) with an outlet to a PC Polygraf HR, Synectics Medical® (Stockholm, Sweden). The manometric catheter was continuously perfused with filtered water at a flow of 0.5 mL/minute by a low compliance perfusion system (J. S. Biomedicals, Inc®, CA, USA). The data were recorded and stored in a PC with a Pentium® processor.

The exam was started with the patient sitting down, with the nasal cavity being anesthetized with 2% lidocaine gel. The probe was inserted through the nostril and positioned with the proximal channel located in the PET region, characterized by increased pressure. After 10 minutes of adaptation to the probe, the subject was asked to produce the vowel "a" twice with a 30 second interval between emissions, using his habitual vocal intensity and frequency. Intraluminal PET pressure was assessed by manometry at rest and during phonation by considering amplitude measurements (mmHg).

The data obtained were tabulated and analyzed descriptively using the mean, standard deviation, median, and range.

Results

According to the analysis of the experts regarding tracheoesophageal voice and speech, , 16.7% of the total laryngectomized patients were characterized as good speakers, 52.5% as moderate speakers, and 30.8% as poor speakers.

The results of manometry are presented in Table 2, and the pressure findings according to voice and speech proficiency are presented in Table 3.

TABLE 1. Adaptation of the Specialist Scoring System applied to the model of Fehring (1994) and modified by Jesus (2000) for selection of the experts.

Criterion	Score
Master's degree in Speech Therapy/Head and Neck Surgery	4
Master's degree in Speech Therapy/Head and Neck Surgery – Thesis with a relevant content within the area	1
Research in the area of evaluation of interest (with publications)	2
Paper published in the area of evaluation of interest in a reference journal	2
Clinical practice of at least one year of duration in the area of Speech Therapy/Head and Neck Surgery	1
Certificate (Specialization) in a Head and Neck area with proven clinical practice	2
Doctorate in the evaluation of interest	2

TABLE 2. Description of the amplitude of the intraluminal pressure of the pharyngoesophageal transition, in mmHg, during phonation and at rest.

	Amplitude of the intraluminal pressure			
Situation	**Mean**	**SD***	**Range**	**Median**
Phonation	32.61	17.18	10.00 – 68.80	29.10
Rest	10.42	10.70	1.70-33.30	5.90

*SD: Standard deviation

TABLE 3. Description of the amplitude of the intraluminal pressure of the pharyngoesophageal transition during phonation and at rest according to the analysis of tracheoesophageal voice and speech proficiency by experts.

		Amplitude of intraluminal pressure			
Situation	**Proficiency of tracheoesophageal voice and speech**	**Mean**	**SD***	**Range**	**Median**
Phonation	Good	27.48	13.97	11.3 – 44.70	20.50
	Moderate	30.63	14.94	10.0 – 68.80	35.40
	Poor	38.72	20.16	23.5 – 68.80	25.70
Rest	Good	14.72	8.87	5.00 – 21.20	21.20
	Moderate	13.04	11.84	3.30 – 33.30	6.00
	Poor	3.54	2.22	1.70 – 6.60	2.00

*SD: standard deviation.

Discussion

Most of the present participants were defined as moderate speakers, a characteristic also observed in other studies21-22. The discrepancies observed in the perceptive analyses may have resulted from the different methodologies applied, such as material for stimulation, tasks, experience of the listener, and protocol used, among others 23. In addition, the wide variation in the acquisition of alaryngeal communication may derive from the use of different criteria for the definition of a good voice24. The more demanding the assessment, the more judicious the result. In other words, characterizing voice quality separately is different from considering voice and speech proficiency, when alteration in just one of these parameters is already sufficient to compromise the final judgment of a tracheoesophageal speaker.

When we correlated the final judgment of voice and speech proficiency with mean PET pressure we noted that the best speakers had the lowest pressure amplitude during phonation and the highest at rest. Aguiar-Ricz13 observed that the resting PET pressure was lower in the group of tracheoesophageal speakers than in non-speakers, suggesting that low PET pressure at rest may be related to the quality of acquisition of tracheoesophageal voice and speech. Chone et al.11 detected a mean pressure values of 11.76 mmHg in total laryngectomized patients without spasms and a value of 25.36 mmHg in those with spasms, with all the subjects in the latter group presenting mean pressures of more than 16 mmHg.

Compared to the present study, these findings show lower pressure values since the best speakers had a higher mean pressure amplitude than the subjects with spasms reported in this last study. Despite the lack of similarity between the results, all data demonstrated the importance of PET for the characterization of alaryngeal speakers. However, Aguiar-Ricz et al.10 concluded that the pressure of the cricopharyngeal segment is not a preponderant factor for the acquisition of esophageal voice and speech.

After total laryngectomy, the interruption of the upper digestive tract and the section of the cricopharyngeal muscle alter the high pressure zone of the PET, impairing its relaxation10. In addition, section of the vagal branches causes local impairment of the function of the upper and lower esophageal sphincters and abnormal esophageal peristalsis25. Since the PET consists of striated muscles, under physiological conditions there is no possibility of continuous contraction26. Thus resting PET is suggested to have a higher pressure value for the better speakers as a function of the presence of remaining mucosa and musculature, and the preserved transverse cricopharyngeal fasciculus possibly contributed to the supply of resistance. This condition, together with the proximal esophageal air pressure, may be responsible for the increased pressure generated during phonation and, among better speakers, the sum of these forces must occur in an equilibrated manner.

The success of tracheoesophageal voice is related to the morphophysiology of the PET, since good and moderate voices are associated with the presence of a pharyngoesophageal prominence consisting of the remaining musculature and mucosa, together with an air chamber and being shorter among good speakers than among moderate speakers9. This region differs according to the shape and rigidity of the scar present between the hypopharynx and the esophagus, tumor location, previous surgeries, and extension of the mucosa27.

In patients whose voice is characterized as good, the minimum distance between the prominence and the anterior wall of the pharynx during rest and phonation is smaller than that of patients whose voice is poor, demonstrating the need for optimal PET closure associated with some tension in order to produce good alaryngeal voice7. Irregularity of the posterior wall of the esophagus may influence the airflow, resulting in greater turbulence and possibly providing a smaller area of contact between the pharyngeal walls when the size of the PET is small or causing an asynchronous mucosal wave in the presence of a very large PET12. In the present study, the patients showing the worst results regarding voice proficiency and speech possibly had an elevated air flow in order to compensate for the lack of resistance provided by the prominence of PET, when present.

When correlating the pressure values of PET with the level of tracheoesophageal voice and speech proficiency it is necessary to keep in mind that the final voice quality of the speaker depends on other anatomophysiological aspects that may contribute to the understanding of cases in which pressure amplitude did not agree with speaker classification, i.e., higher pressure values in phonation and poorer speakers or lower pressure amplitude and better speakers.

Individuals having received radiotherapy or not were admitted to the study, since this procedure does not interfere with voice and speech training in laryngectomized patients28-29, with the placement

of a TEP in irradiated tissue being fully viable30. In the present study, only two laryngectomized patients had not received complementary radiotherapy, so that it may be concluded that radiotherapy may not be a factor that impairs the performance of oral communication.

The field of study of PET behavior in total laryngectomized patients is vast, requiring dedication on the part of researchers. Thus, in order to acquire more reliable data in an objective and measurable manner for a better characterization and previous definition of candidates for a TEP, it is essential to conduct multidisciplinary investigation and to conduct specific exams such as manometry in addition to clinical phonoaudiologic evaluation.

Conclusions

The best speakers presented the lowest pressure, in contrast to poor speakers during phonation. Conversely, resting pressure was higher in good speakers and lower in poor speakers, suggesting that low pressure at rest may favor a compensatory behavior of the PET for phonation, increasing local pressure and impairing the quality of communication.

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