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Original Article

Aerodynamic Analysis Of Voice In Persons With Laryngopharyngeal Reflux

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Abstract:

Objectives of the study: The individuals with laryngopharyngeal reflux are prone for aspiration of refluxed contents and so there is a need for aerodynamic evaluation in these individuals. Hence, the present study investigated the aerodynamic characteristics in individuals with Laryngopharyngeal reflux. **Study design:** Prospective control group design. **Method:** Thirty laryngopharyngeal reflux subjects and 30 normal subjects participated in the study. Aerodynamic parameters such as vital capacity, mean air flow rate, maximum phonation duration and phonation quotient were measured using Aero Phone Instrument ((Model 6800). Independent t test was employed for statistical inference. **Results:** The results revealed that the vital capacity and maximum phonation duration values were lower for laryngopharyngeal reflux subjects when compared to normal controls. No significant differences were observed for mean air flow rate and phonation quotient. **Conclusions:** The results revealed that the laryngopharyngeal reflux individuals showed significant deviations in aerodynamic parameters when compared to normal individuals. Thus study confirms aerodynamic abnormalities in laryngopharyngeal reflux subjects.

Key Words: Laryngopharyngeal Reflux, Aerodynamic measures, Dysphonia.

Introduction:

Gastroesophageal reflux (GER) is a normal physiological phenomenon experienced by every person in his life time. It is a condition in which contents of the stomach regurgitates into the esophagus and laryngeal structures. It is a relatively common disorder with an estimated lifetime prevalence of 25% to 35% reported in the U.S. population[1]. GER may be physiologic and the occurrence of as many as 50 GER episodes a day, usually after meals[2] or once in an hour[3] is accepted to be within the normal range.

Depending on the extent of reflux, two conditions are being identified. Gastroesophageal reflux disease (GERD) and Laryngopharyngeal reflux (LPR)[4]. GERD is caused by the back flow of food and gastric contents only up to the esophagus, which leads to tissue damage or oesophagitis and heart burn. LPR is caused due to back flow of stomach contents not only to the esophagus but all the way up to the laryngopharynx, producing symptoms such as hoarseness, globus sensation in the throat, chronic cough and sore throat.

Several studies have attempted to systematically and objectively assess and describe voice changes related to LPR. The acoustic and perceptual abnormalities in individuals with LPR reveal mild elevation of jitter, shimmer and noise related measures[5,6,7,8] (Shaw, Searl, Young and Miner, 1996; Hamdan, Sharara, Yunes, Fuleihan, 2001; Cesari, Galli, Ricciardiello, Cavaliere and Galli, 2004; and Oguz, Tarhan Korkmaz, Yilmaz, Safak, Demirci & Ozluoglu, 2006) Aerodynamic measure evaluates the status of the respiratory system. Aerodynamic abnormalities are reported in various voice disorders including glottal carcinoma and Prader Willi syndrome[9,10] but aerodynamic measures are not well understood in individuals with LPR. Majority of the studies in LPR are restricted to the evaluation of the acoustic and perceptual parameters.

Purpose of the study:

There is very little understanding of aerodynamic characteristics of individuals with LPR. Given the patho-physiology of LPR, it is to be expected that aerodynamic characteristics are more likely to be deviant in LPR. There is no study which has analysed the aerodynamic abnormalities in individuals with LPR. Hence the present study was taken up to delineate the specific aerodynamic abnormalities if any in individuals with LPR.

Methods:

Subjects:

Subjects were divided into two groups, Clinical group and control group. The clinical group consisted of 15 adult males and 15 adult females in the age range of 20-40 years diagnosed as having LPR. The diagnosis of LPR was based on the ambulatory 24 hour pH Monitoring conducted by an experienced Gastroenterologist. All the LPR subjects had a ph in the range of 3-5. The control group (N=30) consisted of 15 male and 15 female adults between the ages of 20-40 years matched for height and weight. All the subjects in the control group had pH value greater than 7 in the 24 hour pH monitoring. Further, perceptual evaluation by trained SLPs revealed normal characteristics of voice at the time of study. Informed consent was obtained from all the subjects who participated in the study and the protocol was approved by the institutional ethics committee.

The exclusion criteria for both the groups included vocal etiologies such as vocal abuse/ misuse; exposure to toxic fumes and chemicals; and other systemic diseases like diabetes mellitus and hormonal dysfunction; and the medical treatments for LPR in specific.

Instrumentation:

The Aerophone 2 Voice function analyzer (Kay Aerophone 2, 6800; Kay Elemetrics Corporation) was used for the aerodynamic measurements.

Procedure:

Amongst the aerodynamic measures, the vital capacity, mean air flow rate, maximum phonation duration and phonation quotient were measured. For the measurement of vital capacity, the subjects were instructed to take a deep breath and blow slowly as long as possible into the mouth piece connected to the aerophone. The subjects were instructed to take a deep breath and phonate /a/ as long as possible into the mouth piece connected to the aerophone for the measurement of mean airflow rate.

The phonation quotient was calculated as:

Phonation quotient= vital capacity / Maximum phonation duration.

The maximum phonation duration was measured by noting down the time taken for producing a sustained phonation of /a/ sample using stop watch. Three trials of the measurement were taken for all the parameters and the longest attempt was considered for analysis.

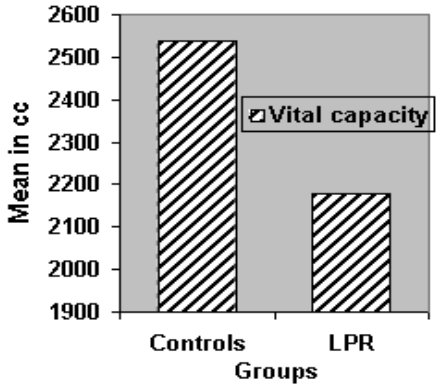
Appropriate instructions were given to all the subjects before performing the task. Instructions were repeated as and when required. All the aerodynamic measurements were carried out in a standing position in a sound treated room. The obtained data was analysed statistically with SPSS 10.0 for Windows (SPSS Corporation, Chicago, IL). Descriptive statistics was employed to find the mean and standard deviation of the aerodynamic measures in the clinical and control groups.

Results:

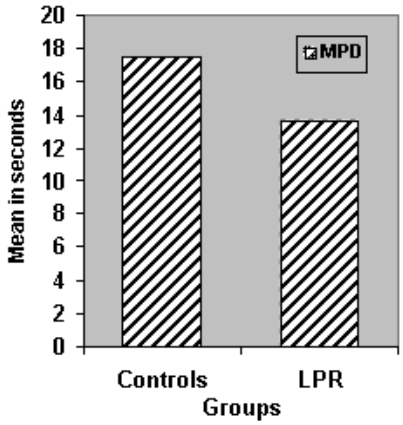
The present study investigated the aerodynamic characteristics of voice in subjects with LPR. Amongst the aerodynamic measures, only the vital capacity and maximum phonation duration were included and shown in Graphs 1-4.

Graph 1 and 2 depicts the vital capacity and maximum phonation duration in male individuals.

Graph 1: Vital capacity in Controls and LPR



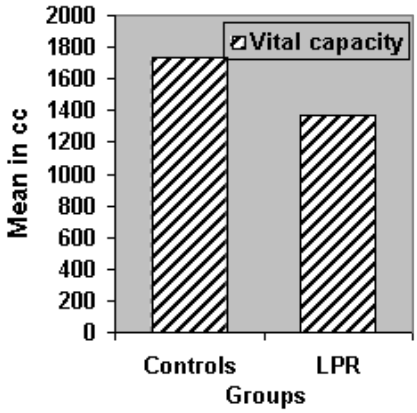
Graph 2: MPD in Controlsl and LPR



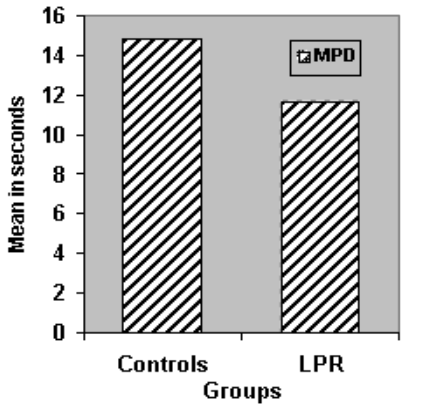
The results in the graphs 1 and 2 reveal lower values of vital capacity and maximum phonation duration in male LPR subjects when compared to normal controls.

Following are the graphs depicting vital capacity and Maximum phonation duration in female individuals.

Graph 3: Vital capacity in Controls and LPR



Graph 4: MPD in Controls and LPR



The results in the graphs 3 and 4 reveal lower values of vital capacity and Maximum phonation duration in female LPR subjects when compared to control subjects.

Independent t test which was conducted to compare the significant difference between means of controls and LPR individuals revealed significant difference between means at $p<0.001$ level. There was no significant difference observed between means of controls and LPR individuals for phonation quotient and Mean air flow rate.

Discussion:

LPR is found to be associated with a wide spectrum of voice disorders including hoarseness, voice fatigue and hypertonic phonation[2,4,6,11]. Several studies have attempted to systematically and objectively assess the voice changes related to LPR.

Because the vocal folds are activated for phonation by the outflowing airstream passing through the closed glottis, assessment of respiratory system is a vital part of voice evaluation. The commonly employed assessment procedures include aerodynamic measures such as vital capacity, mean airflow rate, phonation quotient, and maximum phonation duration and s/z ratio. These parameters were reported to be abnormal in subjects with voice disorders like that of glottal carcinoma[9].

Aerodynamic measures such as vital capacity, mean airflow rate, phonation quotient and maximum phonation duration were measured in individuals with LPR in the present study. It was found that the vital capacity and MPD were significantly deviant in subjects with LPR in comparison to normals. This could be attributed to the respiratory insuffiency caused by aspiration due to reflux suggesting mild pulmonary obstruction (Spiegel, Sataloff, Cohen, Hawkshaw and Epstein, 1998).

The findings of this study suggest that LPR subjects did exhibit evidence of tendency for aerodynamic abnormalities. Voice related deviation in LPR are explained as sprinkling of acid contents on to the laryngeal structures due to the reflux as well as the reduced pulmonary effeciency caused because of aspiration of refluxed contents. So the present study throws light on the aerodynamic characteristics of voice in subjects with LPR and the contribution of LPR as an etiological agent for the cause of dysphonia. The present study further recommends the evaluation of other aerodynamic parameters in individuals with LPR.

Conclusion:

The present study investigated the aerodynamic measures in subjects with LPR. The results revealed that the LPR individuals showed significant deviations in aerodynamic parameters when compared to normal individuals. Thus study confirms subtle aerodynamic abnormalities in LPR subjects in comparison to normal controls as evidenced from aerodynamic measures. The results of the present study throw light on LPR as a significant etiological factor for dysphonias. These findings may not carry diagnostic potentials but do substantiate further the strong interplay between various systems. Follow up studies that include other airflow measures may help further in understanding the present findings.

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