Abstract

Objectives: When measuring subglottal pressure using airflow interruption, subjects must maintain constant pitch and glottal configuration. However, because of audio-laryngeal reflexes, this is difficult and leads to high intrasubject variability. Auditory masking was used with the airflow interruption system to "mask" laryngeal reflexes and improve the consistency of intrasubject subglottal pressure (SGP) measurements.

Methods: Subglottal pressure was tested using the airflow interruption system described in Jiang et al., 1999. Fifteen subjects performed ten trials without and ten trials with auditory masking. Subjects were instructed to phonate /a/ and supraglottal pressure was measured for 500 ms. Following the set of ten normal trials, a five second recording of each subject’s phonation was played over headphones to “mask” laryngeal reflexes. A paired t-test was performed to determine if there was a statistically significant difference between trials performed without and with masking.

Results: Intrasubject consistency was improved in all subjects following the addition of auditory masking. A paired t-test yielded a p-value < .001, indicating a statistically significant difference between mean standard deviation without (1.286 +/- 0.471) and with (0.57 +/- 0.23) masking. This improvement in intrasubject consistency can be attributed to masking providing both a target pitch as well as feedback that blocked distracting noises caused by the airflow interrupter. Conclusions: Adding auditory masking improved the airflow interruption system, decreasing intrasubject standard deviations. Auditory feedback was used effectively to combat audio-laryngeal reflexes induced by the balloon valve interruption. Using auditory masking led to more consistent results, improving the utility of the airflow interrupter and facilitating its application to the clinical setting.

Introduction

It is difficult to obtain accurate, consistent data when testing subglottal pressure (SGP) in the clinic. Invasive methods measuring SGP directly by placing a pressure transducer in the trachea are not feasible due to time constraints and patient discomfort. Audio-laryngeal reflexes make it difficult to maintain a constant pitch and glottal configuration throughout a test. Bard found a correlation between intraoral subglottal pressure and subglottal pressure using mechanical interruption (1). Building on this principle, Jiang et al. (2) developed the airflow interruption system using a balloon valve (2), but its clinical applicability has been hindered by high intrasubject variability. Ambient noise created by the device distracts subjects, eliciting audio-laryngeal reflexes which lead to changes in glottal configuration. To improve consistency, auditory feedback must be considered. A previously recorded sample of each subject’s phonation was played over headphones to “mask” laryngeal reflexes, blocking out ambient noise and providing a target pitch for subjects while testing. The airflow interruption method described by Jiang et al. (2) was used to measure subject SGP (figure 1). Adding auditory masking increased intrasubject reliability and led to more consistent, accurate measurements of SGP.

Methods and Materials

Experimentation setup. The experimental design is identical to the setup described in Jiang 1999 with the exception of adding headphones and Microsoft Voice Recorder software used for auditory masking. Also, a mouthpiece was used instead of a mask (figure 2) to eliminate variability described in Jiang 1999 with the exception of adding headphones and supraglottal pressure measurements during phonation by airflow. Laryngoscope 1999; 109(3):425-32.

Data analysis. Subglottal pressure graphs were obtained. A plateau representing the equilibration of supraglottal pressure with subglottal pressure was determined and recorded as the subject’s SGP (figure 3). A paired t-test was performed to determine if there was a statistically significant difference in the average intrasubject standard deviation between trials without and with auditory masking.

Results

Intrasubject consistency was improved in all subjects following the addition of auditory masking to the standard airflow interruption setup (figure 4). A paired t-test yielded a p-value < .001, indicative of a statistically significant difference between mean standard deviation without (1.29 +/- 0.47) and with (0.57 +/- 0.23) masking. Average subglottal pressure measurement for all subjects was 7.57 cmH2O without masking and 7.35 cmH2O with masking. Masking did not appear to have a definitive impact on average intersubject SGP. The purpose of using masking is to produce more consistent intrasubject data, which was observed. The observed improvement in intrasubject consistency can be attributed to masking providing both a target pitch as well as auditory feedback which blocked distracting noises caused by the airflow interrupter.

Conclusions

The addition of auditory masking improved the airflow interruption system by increasing intrasubject consistency. An effective method of providing immediate and reliable noninvasive subglottal pressure measurements is useful in both the research and clinical settings. Many current methods require subjects to maintain a constant glottal configuration and pitch. Auditory masking has the potential to benefit these methods, as it can prevent confounding audio-laryngeal reflexes and provide subjects with a target pitch. The use of masking in this study improved the utility of the airflow interrupter, facilitating its application to the clinical setting.

References