

# Aerodynamic Measures and Biofeedback as Management in Persistent Paradoxical Vocal Fold Motion and Reverse Phonation

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**Summary: Objectives.** Paradoxical vocal fold motion (PVFM) and reverse phonation are characterized by aberrant vocal fold adduction. To date, there have been no studies examining the aerodynamic events during reverse phonation. We present an unusual case of persistent reverse phonation secondary to respiratory distress associated with PVFM.

**Study Design.** Case report.

**Methods.** We present the case of a 42-year-old female with sudden onset of respiratory distress associated with PVFM and persistent reverse phonation. She underwent baseline aerodynamic measurements followed by trial therapy. Through the use of instrumental and tactile aerodynamic biofeedback, the patient was able to coordinate exhalatory breath pressure flow during phonation, which resulted in immediately improved voice quality from highly dysphonic to nearly normal voice quality.

**Conclusions.** Patients with reverse phonation seldom undergo aerodynamic testing as part of the initial diagnostic and management program. Our case study demonstrates the effectiveness of aerodynamic technology to enable a patient with aberrant glottic function to recognize inspiratory phonation events and to reestablish consistent expiratory flow/pressure egress in speech tasks. Instrumental and tactile biofeedback is effective for reinforcement of normal flow patterns during speech tasks.

**Key Words:** Reverse phonation–Paradoxical vocal fold motion–PVFM–Laryngospasm.

## INTRODUCTION

Paradoxical vocal fold motion (PVFM) is an uncommon disease characterized by vocal fold adduction during inspiration and/or expiration and functional airway obstruction due to the aberrant active adduction of the vocal folds during inspiration.<sup>1,2</sup> Adductive laryngospasms may be triggered by an excessive response to external and internal airway stimuli.<sup>2</sup> Prolonged vocal fold adduction during inhalation in an effort to achieve phonation, also known as reverse phonation, is also uncommon as a dominant mode of phonation. To date, there have been no studies examining the aerodynamic events during reverse phonation. We present an unusual case of persistent reverse phonation secondary to respiratory distress associated with PVFM. Presence of reverse phonation was documented during aerodynamic and stroboscopic examination.

## Case

A 42-year-old female executive with report of a previously strong voice and normal articulation presented with a 1 month history of persistent hoarseness, dyspnea, and difficulty coordinating breath during speech. Patient presented following recent hospitalization at an outside hospital 1 month prior, for a first-time onset of respiratory distress and apparent PVFM and a diagnosis of an acute upper respiratory infection. She experienced a distinct sensation of swelling in the nose and throat, difficulty breathing, notable stridor, and change in voice. She was admitted for 4-day

intensive care unit admission for close observation without intubation. Bedside fiberoptic laryngoscopy by an otolaryngologist during her hospital stay revealed physical findings consistent with severe acid reflux for which she was already being medically treated. Her past medical history is significant for systemic lupus erythematosus and gastroparesis with frequent vomiting. She had experienced an episode of reflux and regurgitation within 2 days of onset of symptoms. She is married, has two small children (aged 2 and 7 years), and admits to high-stress job.

Physical examination findings were significant for a grade-3, roughness-3, breathiness-0, aethenia-0, and strain-3 ( $\Sigma = 9$ ) with reverse phonation present during initial laryngeal examination (day one). Laryngeal videostroboscopy was significant for obvious PVFM, with phonation present during inspiration and expiration and otherwise normal laryngeal anatomy ([Supplementary Video 1](#)). Despite voicing, no mucosal wave was generated during stroboscopy. Mean speaking fundamental frequency (SF0) during stroboscopy was 454 Hz.

Chronic cough was not observed, but high mucosal sensitivity was present. The patient was referred for baseline aerodynamic measures and trial speech/voice/breathing therapy the following day.

Aerodynamic measures were obtained using KayPentax Phonatory Aerodynamic System (KayPentax, Montvale, NJ), with repeated /pa/ syllable trains. Patient reported her speech and voice quality on that day to be representative of typical speech. Reverse phonation of her was dominant speech pattern, with voice quality rough, coarse, and dry.

Patient was observed to have initial pressure peak for [p] in /pa/ syllable trains, but then minimal (0.54 cm H<sub>2</sub>O) or no measurable pressure peak during subsequent [p] production during the remainder of task ([Figure 1A](#) and [B](#)). Although initially attributed to be due to possible saliva in the intraoral tube, later [p] productions in the same syllable train did have

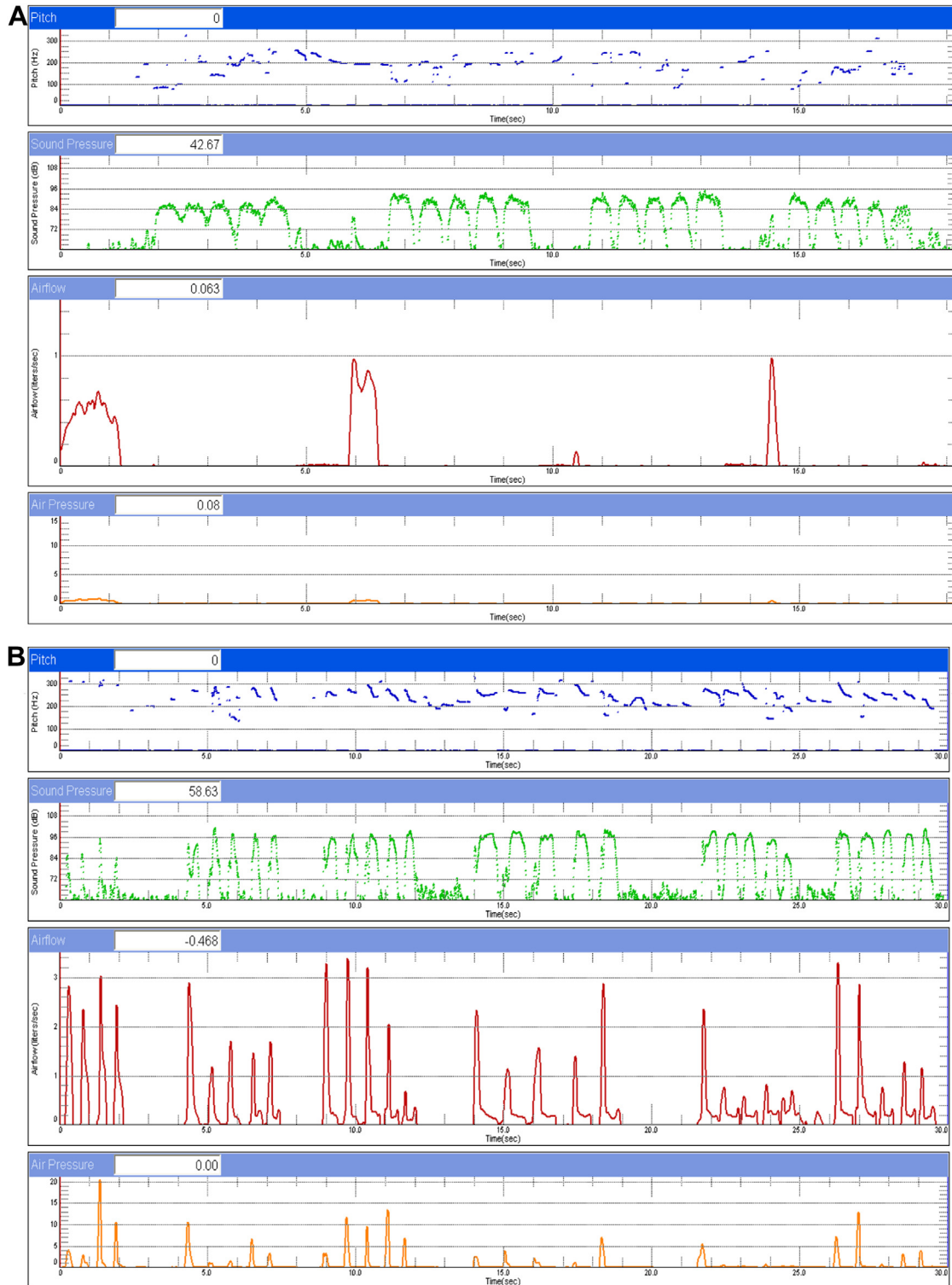
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**FIGURE 1.** (A) Subject phonation of /papapapa/ showing erratic air flow and air pressure tracings despite voicing at  $\sim 230$  Hz. (B) Repeated /papapapa/ with improved use of positive pressure egress but with variable control of normal versus inhalation phonation  $\sim 230$ – $250$  Hz.

positive pressure peaks. Clearance of potential saliva through repeated [p] did not change the variable positive-flat-positive pressure tracings during the repeated /pa/ syllable trains. Careful monitoring of adequate labial seal during flattened pressure tracings and evidence of positive pressure peaks within

the same repeated /pa/ task confirmed inspiratory phonation during the syllable train. Air flow, loudness, and pitch were measurable for these events, confirming that patient was using inhalation phonation (negative pressure during /p/, positive flow during /a/).

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