Diaphragmatic Breathing Reduces Belching and Proton Pump Inhibitor Refractory Gastroesophageal Reflux Symptoms

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BACKGROUND & AIMS: **In patients with gastroesophageal reflux disease (GERD) and excessive belching, most belches are supragastric, and can induce reflux episodes and worsen GERD. Supragastric belching (SGB) might be reduced with diaphragmatic breathing exercises. We investigated whether diaphragmatic breathing therapy is effective in reducing belching and proton pump inhibitor (PPI)-refractory gastroesophageal reflux symptoms.**

METHODS: **We performed a prospective study of 36 consecutive patients with GERD refractory to PPI therapy and a belching visual analogue scale (VAS) score of 6 or more, seen at a gastroenterology clinic at a tertiary hospital in Singapore from April 2015 through October 2016. Patients underwent high-resolution manometry and 24-hour pH-impedance studies while they were off PPIs. Fifteen patients were placed on a standardized diaphragmatic breathing exercise protocol (treatment group) and completed questionnaires at baseline, after diaphragmatic breathing therapy, and 4 months after the therapy ended. Twenty-one patients were placed on a waitlist (control subjects), completed the same questionnaires with an additional questionnaire after their waitlist period, and eventually received diaphragmatic breathing therapy. The primary outcome was reduction in belching VAS by 50% or more after treatment. Secondary outcomes included GERD symptoms (evaluated using the reflux disease questionnaire) and quality of life (QoL) scores, determined from the Reflux-Qual Short Form and EuroQoL-VAS.**

RESULTS: **Nine of the 15 patients in the treatment group (60%) and none of the 21 control subjects achieved the primary outcome ($P < .001$). In the treatment group, the mean belching VAS score decreased from 7.1 ± 1.5 at baseline to 3.5 ± 2.0 after diaphragmatic breathing therapy; in the control group, the mean VAS score was 7.6 ± 1.1 at baseline and 7.4 ± 1.3 after the waitlist period. Eighty percent of patients in the treatment group significantly reduced belching frequency compared with 19% in control subjects ($P = .001$). Treatment significantly reduced symptoms of GERD (the mean reflux disease questionnaire score increased by 12.2 in the treatment group and 3.1 in the control group; $P = .01$). The treatment significantly increased QoL scores (the mean Reflux-Qual Short Form score increased by 15.4 in the treatment group and 5.2 in the control group; $P = .04$) and mean EuroQoL-VAS scores (15.7 increase in treatment group and 2.4 decrease in the control group). These changes were sustained at 4 months after treatment. In the end, 20 of the 36 patients who received diaphragmatic breathing therapy (55.6%), all with excessive SGB, achieved the primary outcome.**

CONCLUSIONS: **In a prospective study, we found a standardized protocol for diaphragmatic breathing to reduce belching and PPI-refractory gastroesophageal reflux symptoms, and increase QoL in patients with PPI-refractory GERD with belching—especially those with excessive SGB.**

Keywords: Involuntary Diaphragmatic Contraction; Acid Reflux; Controlled Trial; Speech Therapy; Supragastric Belching; Diaphragmatic Breathing; PPI Refractory.

Abbreviations used in this paper: **DB, diaphragmatic breathing; GB, gastric belching; GERD, gastroesophageal reflux disease; HADS, Hospital Anxiety and Depression Scale; LES, lower esophageal sphincter; PPI, proton pump inhibitor; QoL, quality of life; RDQ, Reflux Disease Questionnaire; RQS, Reflux-Qual Short Form; SGB, supragastric belching; VAS, visual analogue scale; WLC, wait-list control subjects.**

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Proton pump inhibitor (PPI)-refractory gastroesophageal reflux disease (GERD) is a pressing clinical problem constituting around 30% of patients with GERD.[1] In patients with GERD, 40%–49% complain of belching as a predominant symptom.[2,3] Previously, patients with excessive belching were thought to swallow air frequently or in large volumes[4] resulting in air venting from the stomach, known as gastric belching (GB). Recently, it has been shown that supragastric belching (SGB) is the predominant type of belching in patients with GERD with excessive belching.[3,5,6] The underlying mechanism of SGB is involuntary diaphragmatic contraction resulting in rapid influx of air into the esophagus, followed by rapid air expulsion.[7] It has been shown that SGB can exacerbate GERD symptoms by directly inducing reflux episodes.[3,5,6] PPIs are used widely in GERD treatment and have been used for belching,[8–11] but do not directly address the pathophysiology of SGB.

A single pilot study[12] has shown diaphragmatic breathing (DB) to be useful in SGB treatment but did not address whether GERD symptoms improved. To our knowledge, no study has determined whether DB is useful in patients with GERD and belching. We hypothesize that DB reduces belching and reflux symptoms in PPI-refractory patients with GERD with excessive belching. Therefore, we aimed to determine if DB is efficacious in improving belching and GERD symptoms, and in turn, improve quality of life (QoL).

Materials and Methods

Patient Selection

The study started in April 2015 when consecutive patients attending the gastroenterology clinic in a tertiary hospital in Singapore were invited to join after fulfilling inclusion criteria. Inclusion of patients ended in October 2016 and follow-up of last patient ended in April 2017.

The study design was a wait-list controlled cohort study. We included adult patients (≥18 years) with clinical or endoscopic diagnosis of GERD, according to Montreal definition[13] and LA grade greater than or equal to B esophagitis, respectively. Patients needed to have troublesome belching over the last 6 months, with a belching visual analog scale (VAS) score of ≥6. All patients had PPI-refractory GERD, defined as having troublesome GERD (heartburn and/or regurgitation) despite twice daily PPI therapy for 12 weeks.[1] Organic or metabolic diseases were excluded by routine biochemistry and upper gastrointestinal endoscopy. Other exclusion criteria included pregnancy, patients with extreme body mass index (<18 or >35), or surgery involving the gastrointestinal tract because these may alter anatomy and physiology of the esophagus and stomach.

Informed consent was obtained from each participant and protocol was approved by Singhealth Centralised Institutional Review Board before the start of study. Wait-list control subjects (WLC) were not aware of an active treatment arm being compared with but were told that their symptoms would be reviewed at the end of the wait-list period and receive treatment regardless of their symptoms.

Questionnaires

All patients were given questionnaires at baseline, at the end of treatment with DB exercises, and 4 months post-treatment, with WLC given an additional questionnaire after their wait-list period (Figure 1). Because there were no validated questionnaires on belching, we asked patients to quantify their belching severity over the last 1 week via a 100-mm VAS, along with questions on frequency, ability to control, and repetitive nature of belching. To assess frequency and severity of GERD, patients were given the Reflux Disease Questionnaire (RDQ), which was validated in evaluating treatment response in GERD.[14] The RDQ consists of heartburn, regurgitation, and dyspepsia domains and assigns a score for these domains based on frequency and severity.[15] We measured GERD-specific QoL via Reflux-Qual Short Form (RQS)[16] and general health-related QoL via the EuroQol VAS.[17] Anxiety and depression levels were assessed using the Hospital Anxiety and Depression Scale (HADS).[18] Severity of somatic symptoms were assessed using the Patient Health Questionnaire-15.[19]

Our primary outcome measured was ≥50% reduction in belching VAS at the end of treatment. Our secondary outcomes included improvements in reflux symptoms via RDQ and health-related QoL scales via RQS and EuroQol VAS.

pH-Impedance Measurements

High-resolution esophageal manometry (Medtronic Inc, Shoreview, MN) was performed to identify the position of the lower esophageal sphincter (LES) and rule out significant esophageal dysmotility. A combined pH-impedance catheter (Sandhill Scientific, Highlands Ranch, CO) was then placed transnasally at 5 cm above the LES. All patients underwent these tests and results were analyzed manually by 2 operators (A.M.-L.O., Y.-T.W.), both blinded to patient characteristics and questionnaire outcomes. All drugs affecting acid suppression, gastrointestinal motility, or sensitivity were discontinued at least 1 week before.

Gastric belches (Figure 2*A*) and supragastric belches (Figure 2*B*) were defined as previously described.[20] Patients were labelled as having excessive SGB if they had >13 supragastric belches per 24 hours.[6] Severe

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