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ORIGINAL ARTICLE

Halitosis and gastroesophageal reflux disease: a possible association

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OBJECTIVE: Previous reports have suggested that gastrointestinal (GI) diseases may cause halitosis. The aim of this study was to evaluate the relationship between upper GI conditions, especially gastroesophageal reflux disease (GERD), and halitosis.

PATIENTS AND METHODS: One hundred and thirty two consecutive patients complaining of upper GI symptoms were included in the study. All the patients completed a validated questionnaire that was designed to characterize and measure the severity of their symptoms. The questionnaire also contained questions about awareness and severity of oral bad breath. Following the filling of the questionnaire, the patients were physically examined and subjected to an upper GI endoscopy.

RESULTS: The final diagnosis among the 132 patients (M/F = 70/62, mean age 45.2 years, range 20–87 years) was GERD in 72 patients (55%), Functional dyspepsia in 52 (39%), Peptic ulcer in seven patients (5%) and gastric cancer in one patient (1%). Halitosis was significantly associated with the occurrence and severity of heartburn ($P = 0.027$), regurgitation ($P = 0.002$) sour taste ($P < 0.001$), belching ($P = 0.001$) and burburigmus ($P = 0.006$). Halitosis was not associated with upper abdominal pain, bloating, early satiety and chest pain. In relation to the final diagnosis, halitosis was significantly associated only with GERD ($P = 0.002$) but not with functional dyspepsia ($P = 0.855$) and peptic ulcer disease (0.765). No correlation was found between *Helicobacter pylori* infection status and halitosis occurrence and severity (analysis of variance $F = 0.001$, $P = 0.977$).

CONCLUSIONS: Halitosis is a frequent symptom of GERD and may be considered as an extra-esophageal manifestation of GERD. On the other hand, we did not find an association between functional dyspepsia, peptic ulcer disease and *H. pylori* infection with halitosis occurrence or severity.

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Introduction

A large proportion of the population suffers from halitosis – a chronic oral malodor condition that causes a significant personal discomfort and social embarrassment (Tessier and Kulkarni, 1991). Although several non-oral sites have been related to oral malodor, it is thought that in the vast majority of cases (80–90%), halitosis originates within the oropharyngeal cavity, where anaerobic bacteria degrade sulfur-containing amino acids to the foul-smelling volatile sulfur compounds (VSC) (Van Steenberghe, 1997). In healthy subjects, the most important source of malodor appears to be the dorsoposterior surface of the tongue where the filiform papillae are the favored sites for growth of the anaerobic bacteria responsible for halitosis. (De Boever and Loesche, 1995).

Several previous studies have suggested that upper gastrointestinal (GI) diseases may cause halitosis. Some reports connected *Helicobacter pylori* infection to halitosis (Hoshi *et al*, 2002).

In recent years, there has been a great focus on the extraesophageal manifestations of gastroesophageal reflux disease (GERD). These manifestations consist broadly of pulmonary diseases and symptoms such as: asthma and chronic cough, non-cardiac chest pain, hoarseness and laryngitis (Close, 2002). It has been shown that these symptoms may occur without any esophageal symptoms such as heartburn or regurgitation and most patients will have a normal-appearing esophagus without any signs of inflammation on endoscopy (Burton *et al*, 2005). Although halitosis was mentioned in relation to GERD in several review articles, the association between them has not been thoroughly evaluated in the medical literature. Given that GERD can potentially affect the pharynx, larynx, and mouth, and the current assumption that most

cases of extraoral halitosis resulted from bacterial growth in the posterior-dorsal part of the tongue, it is reasonable to assume that halitosis might be also a result of GERD.

The aim of this study was to evaluate the rate of halitosis in patients with dyspepsia, and to compare patients with GERD with those with other types of dyspepsia.

Subjects and methods

Subject selection

A total of 139 consecutive subjects presented to the Gastroenterological Department in the Tel Aviv Sourasky Medical Center from January 2002 through May 2003 with uninvestigated upper abdominal symptoms were prospectively investigated. Inclusion criteria were (1) presence of dyspeptic symptoms such as upper abdominal pain or discomfort, bloating, nausea, vomiting, heartburn, or early satiety; (2) persistence of symptoms for at least 3 months in the last year, and (3) no previous abdominal surgery.

All participants completed a detailed GI symptom questionnaire, which was followed by an interview and physical examination by a gastroenterologist. All subjects were referred to gastroscopy, and 132 out of 139 patients consented to undergo upper GI endoscopy.

Written informed consent was obtained from all the patients and the study was approved by the local ethics committee.

Symptom questionnaire

To classify dyspepsia and to discriminate GERD from other types of dyspepsia a diagnostic symptom questionnaire was developed. The questionnaire was designed to measure both the presence and severity of reflux and other types of dyspepsia using a 5-point Likert-type scale. The evaluated symptoms included the following items: epigastric pain/discomfort, retrosternal pain, heartburn, regurgitation, nausea, vomiting, belching, bloating, early satiety, burburigmus, hiccups, upper abdominal distention, halitosis, sour taste, and stress. The questionnaire also measured the influence of different factors on the patient's symptoms; these factors included: eating, drinking milk, hunger, avoiding certain foods, use of antacids, bending or lying down, and heavy meals. Presence of alarm symptoms (such as GI bleeding, weight loss, vomiting, dysphagia, anemia, GI polyps or tumors and past abdominal surgery) was also addressed.

Subject evaluation

Upper GI endoscopy was performed using Pentax video endoscope. Endoscopists were aware that all patients were being investigated for this study but were blinded to the patients' questionnaire answers. The macroscopic appearance of the esophageal mucosa was recorded according to Los Angeles classification (Lundell *et al*, 1999). Subjects with any grade of esophagitis as seen in endoscopy were diagnosed as having 'reflux disease' (GERD) *vs* 'non-reflux disease.' Finding of 'esophagitis' was made by the physician who performed the gastroscopy and was approved by two other gastroenterologists reviewing the endoscopic findings. In addition, patients were diagnosed as having GERD even when the gastroscopy was normal, according to the following criteria: the medical record of the patients was evaluated by three senior gastroenterologists who were blinded to the symptom questionnaire. Cases were classified as GERD if there were a total agreement between the three gastroenterologists; other cases were diagnosed as 'non-reflux disease.' *Helicobacter pylori* infection diagnosis was made by using Rapid Urease Test (CLO test; Kimberly-Clark/Ballard Medical Products, Drapct, UT, USA) during the endoscopic procedure.

Statistical methods

Stepwise logistic regression was used to choose the best questions in questionnaire for classification. Data mining techniques such as neural network models, decision tree algorithms, and other classification algorithms were used to construct the best classification model to classify GERD.

We used Clementine 8.0 (SPSS Inc., Chicago, IL, USA) and Matlab 7.0 (Mathwork Inc., Natick, MA, USA) for the following data mining models and algorithms: logistic regression, neural networks, and decision trees (C5.0 and Classification and Regression Trees – CART).

Results

A total of 132 patients (M/F = 70/62, mean age 45.2 years, range 20–87 years) presenting with GI complaints were recruited for the study and referred for endoscopy. The combined endoscopic and clinical diagnosis were: GERD in 72 patients (55%), Functional dyspepsia in 52 (39%), peptic ulcer in seven patients (5%) and gastric cancer in one patient (1%).

Table 1 displays the correlation of halitosis with coexisting symptoms. A strong correlation is seen between symptoms that represent typically GERD such as: heartburn, regurgitation, dysphagia, chest pain, belching, and sour taste. Table 2 presents the correlation

Table 1 Correlation of halitosis with other symptoms

Symptom	*Spearman correlation*	*Sig. (two-tailed)*
Stress	0.057	0.525
Heartburn	0.197*	0.027
Regurgitation	0.268*	0.002
Sour taste	0.404*	0.000
Dysphagia	0.167*	0.064
Chest pain	0.156*	0.082
Upper abdominal pain	0.120	0.179
Bloating (upper abdominal)	0.094	0.295
Sickness/throwing up	0.121	0.176
Belching	0.302*	0.001
Heavy meal	0.120	0.180
Full up	0.129	0.150
Early satiety	0.09	0.299
Slow digestion	0.148*	0.099
Burburigmus	0.245*	0.006

*$P < 0.05$

Table 2 Severity of symptoms in patient with or without halitosis

	Mean severity of symptoms (±SD)			
Symptom	*Patients with moderate/ severe halitosis*	*Patients with none/mild halitosis*	*Independent-sample t-test*	*Sig. (two-tailed)*
Heartburn	3.80 (±1.47)	2.79 (±1.53)	−2.4**	0.018
Regurgitation	3.53 (±1.18)	2.41 (±1.42)	−2.9**	0.004
Sour taste	3.66 (±1.44)	1.98 (±1.25)	−4.8**	0.000
Dysphagia	2.40 (±1.29)	1.79 (±1.20)	−1.79*	0.075
Chest pain	2.42 (±1.34)	1.92 (±1.23)	−1.41	0.159
Belching	2.66 (±1.58)	2.25 (±1.42)	−1.04	0.299
Slow digestion	3.20 (±1.42)	2.61 (±1.44)	−1.46	0.146
Burburigmus	3.06 (±1.22)	2.33 (±1.32)	−2.03**	0.044

*$P \leq 0.075$, **$P < 0.05$.

between the severity of halitosis and dyspeptic symptoms. Patients with GERD-typical symptoms have also more severe halitosis than patients with non-GERD.

Table 3 represents the distribution of final diagnoses among patients with and without halitosis. Only diagnosis of GERD was significantly different between patients with and without halitosis.

Figure 1 shows the occurrence and severity of halitosis in various diagnostic groups. Halitosis was significantly more prevalent and more severe among patients with GERD than in patients with other causes of dyspepsia. No correlation was found between *H. pylori* infection status and halitosis existence or severity (analysis of variance $F = 0.001$, $P = 0.977$).

Table 3 Severity of halitosis (1–5) among patients with reflux, peptic ulcer, and functional (non-ulcer) dyspepsia

Diagnosis	*n*	*Mean rank*
GERD	72	74.52*
Non-ulcer dyspepsia	52	55.01
Peptic ulcer disease	7	58.1

GERD, gastroesophageal reflux disease.
*Kruskal–Wallis test, $P < 0.01$

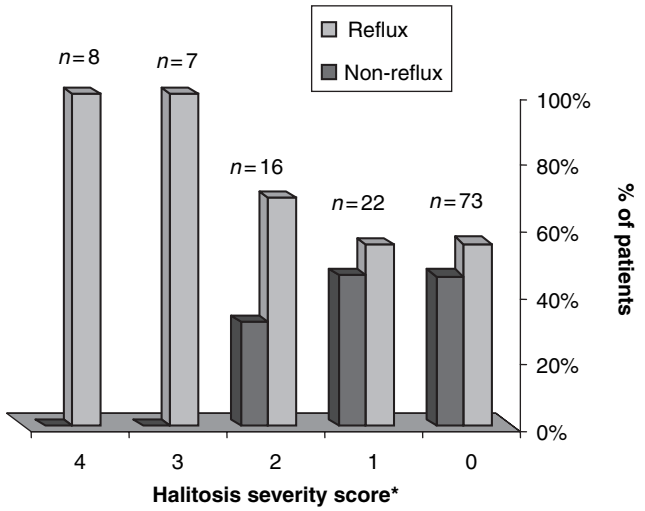

Figure 1 Severity of halitosis in reflux *vs* non-reflux patients

Discussion

The results of the present study indicate a strong association between the occurrence and severity of halitosis and GERD, and the absence of such association with other causes of dyspepsia such as peptic ulcer and *H. pylori* infection. This is the first study to establish a possible association between GERD and halitosis.

There is a common popular belief that once a periodontal disorder has been ruled out, halitosis might be the result of GI disorders and some patients are referred often for GI consultation. However, a direct cause-and-effect relationship has not been established.

It is well recognized that more than 90% of cases of halitosis originate from the oral cavity and it is attributed to VSC produced by oro-pharyngeal bacteria (Tonzetich, 1977). The implicated bacteria are located in stagnant areas in the oral cavity, such as the dorsal surface of the tongue, periodontal pockets, and interproximal areas. Several factors that support the growth of these bacteria and predispose a person to halitosis are well known and include: accumulation of food within pockets around the teeth, among the bumps at the back of the tongue, or in small pockets in the tonsils; sloughed cells from the mouth; diminished saliva flow and mucus in the throat or sinuses. (Kleinberg and Westbay, 1992).

The findings of the present study suggest that GERD might be another possible predisposing factor that serves as a breeding ground for bacteria in the oropharynx.

Extraesophageal manifestations of GERD are frequent, and consist broadly of pulmonary disease, noncardiac chest pain, and ear-nose-throat (ENT) disease (Koufman, 1991). It has been shown that patients often do not have classic symptoms of heartburn or regurgitation (Fennerty, 1999). In a recent study that investigated the prevalence and severity of esophagitis in 405 patients with suspected GERD-related chronic ENT symptoms, almost 40% of patients had halitosis and its occurrence was similar to that of cough, throat ache, and globus sensation (Poelmans *et al*, 2004). Interestingly, in a study that examined oral signs and symptoms in patients with inflammatory bowel diseases (IBD), Katz *et al* (2003) found high rates of GERD and halitosis in this patient group. They did not explain these findings; however, consistent with the results of our study, the high halitosis rate they found is probably related to GERD rather than IBD which is located in the small or large bowels.

There are several possible mechanisms by which GERD might cause halitosis. The first probable mechanism is of direct damage to the oropharyngeal mucosa by the gastroesophageal refluxate, which spills across the upper esophageal sphincter and into the oral cavity. This mechanism is similar to the process suspected to operate in the ear, nose, and throat and asthma presentations of GERD (Irwin *et al*, 1993).

The first mechanism is a direct injury of the oropharyngeal mucosa by the gastric refluxate that may cause inflammation. Mamede *et al* (2004) showed that the prevalence of severe hypertrophy of lymphoid follicles at the base of the tongue markedly increased from 1.6% in healthy population to 7.5% among patients presenting with GERD symptoms such as heartburn, regurgitation, retrosternal burning feeling, and dysphagia. Another possible indirect mechanism is that halitosis is a result of dental erosions, which is a common complication of GERD (Schroeder *et al*, 1995; Gregory-Head *et al*, 2000). Although professional dental examination was not a part of our study, all patients reported a normal and routine dental hygiene, without difference between the patient groups.

In contrast to several studies which linked halitosis with *H. pylori* infection (Tiomny *et al*, 1992; Ierardi *et al*, 1998; Serin *et al*, 2003; Adler *et al*, 2005), our study does not confirm a relation between gastric *H. pylori* infection and halitosis. Serin *et al* (2003) found a higher rate of infection among *H. pylori*-positive patients with non-ulcer dyspepsia (NUD) than in those who were *H. pylori* negative. They also found that *H. pylori* eradication led to dramatic improvement in the halitosis complaints. *Helicobacter pylori* infection in NUD patients is usually limited to the antral mucosa causing mild gastritis and the mechanism by which such condition might cause halitosis is not clear. Even the fact that halitosis disappeared following triple antibiotic therapy might be a result of a temporary eradication of other bacterial species in the oropharynx rather than *H. pylori* eradication. In another study using PCR techniques, *H. pylori* was detected in the saliva, supragingival, and subgingival plaques of periodontitis patients (Gebara *et al*, 2004). Hoshi *et al* (2002) found that levels of hydrogen sulfide and dimethyl sulfide in mouth air were significantly higher in *H. pylori*-positive patients than in *H. pylori*-negative patients; however, odor strength in exhaled breath did not differ significantly between the two groups. Several authors described an association between glossitis, *H. pylori* and halitosis. Adler *et al* (2005) investigated 46 patients with lingual dorsum hyperplasia and halitosis, and found 40 out of 46 (87%) to be *H. pylori* positive in the dorsum of the tongue and 93% of them with *H. pylori* in the stomach also. Although the study population included patients with dyspepsia and burning sensation, they did not refer at all to the possibility of GERD as the cause of glossitis and halitosis, and *H. pylori* colonization of the dorsal of the tongue as a marker of reflux. Gall-Troselj *et al* (2001) described an association between *H. pylori* colonization in the oral mucosa and atrophic glossitis and burning mouth syndrome. They concluded that mucosal changes in these conditions might make the oral environment more acceptable for *H. pylori* colonization compared with normal mucosa. In a recent study by Lee *et al* (2006), *H. pylori* was shown to produce hydrogen sulfide and methyl mercaptan. This suggests that this microorganism can contribute to the development of halitosis.

A possible explanation for the contradictory findings in relation to *H. pylori* infection and halitosis between the present study and the above-mentioned studies might be the fact that we investigated only gastric *H. pylori* infection, and not oro-pharyngeal *H. pylori* infection.

An important limitation of our study should be noted. The evaluation of halitosis was made subjectively using a questionnaire and not with more objective methods such as organoleptic method or volatile sulfide monitoring by a halimeter. Obviously, these objective methods could add to the power of the study; however, a statistically significant correlation was found recently between clinical organoleptic diagnosis of halitosis, SC level by halimeter and subjective patients' opinion evaluated with a questionnaire (Iwanicka-Grzegorek *et al*, 2005).

In conclusion, our results indicate that halitosis might be a result of GERD and that it should be considered as an extraesophgeal manifestation of this disease. Thus, it is important for the dentist as well as for the primary care physician to be familiar with and inquire about typical and atypical reflux symptoms. Early diagnosis and suppression of refluxed acid through lifestyle changes and medications could potentially prevent further unnecessary investigations of this disease, and a communication between gastroenterologists and dentists is imperative for the success of the overall treatment of the patients.

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